PLASTICS TECHNOLOGY

MAY 1960

THE MAGAZINE OF APPLIED ENGINEERING

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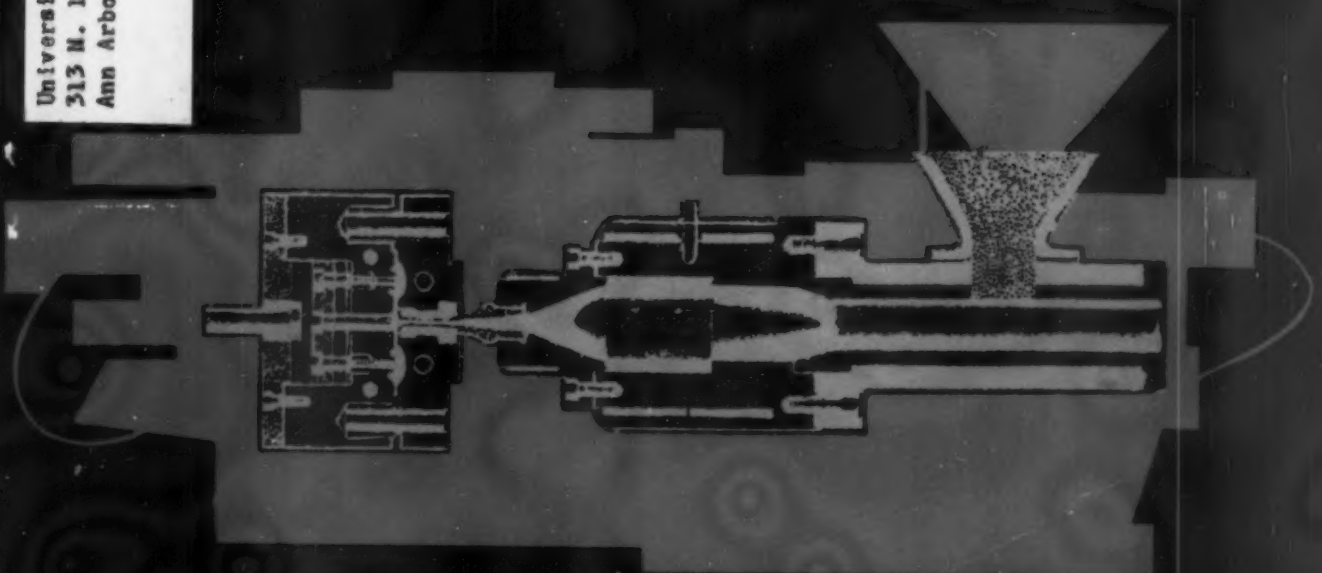
1960 Injection Molding Issue



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PLASTICS
THE MAGAZINE OF APPLIED ENGINEERING
TECHNOLOGY

May 1960, V. 6, No. 5

feature articles:

multi-gating techniques for high-density polyethylene ..... p. 43

by C. L. WEIR

New techniques are described for multi-gating of linear polyethylenes to improve their filling at lower temperatures during injection molding. Differences and advantages are given for three-plate molds; heated-torpedo, multiple-nozzle molds; insulated-runner molds; hot-runner molds; and valve-gated molds. It is emphasized that methods for multiple-gating for other materials do not necessarily hold true for high-density polyethylene.

effects of secondary plasticizers on processing of vinyls—I ..... p. 46

by P. D. SHARPE

A comprehensive test program was undertaken to show the advantages and limitations of secondary vinyl plasticizers. Test results discussed include fusion; compatibility; resistance to extraction in soapy water, gasoline, and oil; volatility; low-temperature flexibility; light stability; migration; odor; color; electrical properties; heat stability; flammability; and tensile properties. Proper blending of plasticizers offers optimum properties in the finished product and cost savings.

production processes for gel-coated glass-polyester plumbing fixtures ..... p. 50

by J. A. WILLS

reinforced-plastics plumbing fixtures require economical, reliable tooling; proper formulations of gel coats; and suitable production processes. The second and third requirements are explained in this article. Mold construction, mold materials, and preparation of mold surfaces for molding are also discussed. Finally, the different molding methods are described, together with their advantages and limitations.

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matching injection molding equipment ..... p. 56

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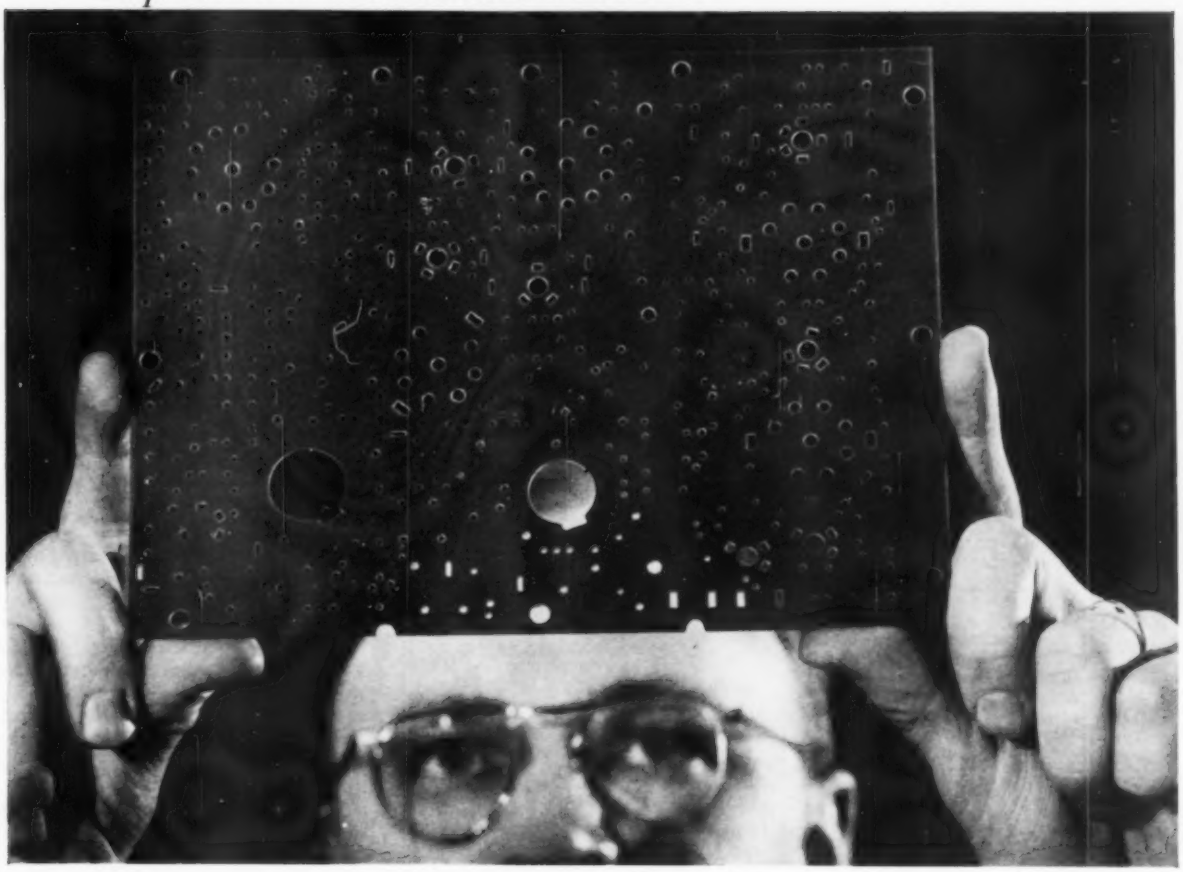

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Letters to the Editors

Irradiated Polyethylene

Dear Sir:

You have been suggested to us as a source of more information on irradiated polyethylene versus chemically cross-linked polyethylene for high temperature wire insulation.

We are interested, too, in learning the types of applications suggested for this type of wire, along with the approximate size of the present market, and an indication of this market's growth potential. Another thing that would be helpful would be an indication of what types of insulation these polyethylenes would replace if they are proved successful.

R. L. Neff
Neff Engineering Associates
Springdale, Conn.

(In replying to this letter, Lee Zukor, our Engineering Editor, noted that polyethylene used for cross-linking or irradiation must contain antioxidants, flame retarders, and other fillers, but these fillers must be limited or omitted when the compound is to be used for electrical insulation. Hook-up wire and other thin-walled constructions are usually processed by irradiation, since the chemically cross-linked material foams badly unless heavily loaded with filler. Chemically cross-linked material can be used when the cross-section is large, as in heavy-cable construction. However, there remains the possibility of continued residual action that could result in failure of the cable due to polymer degradation. As for current market, irradiated polyethylene usage comprises approximately 600,000 pounds per year, with continued growth taking place, while chemically cross-linked polyethylene is limited to specialty applications. —Editor)

Liked February Special Issue

Dear Sirs:

We enjoyed reading the February issue, and wish to compliment you on the fine coverage presented on compression, transfer, and vacuum forming equipment. We are confident that with comparative guides such as these, plastics engineers reading your publication will be much better equipped to make their decisions on new equipment.

D. R. Zelnick, Pres.
Atlas Vac-Machine Corp.
Rochester 17, N. Y.

Liked March Editorial

Dear Sirs:

In my opinion, you have taken a very sensible approach in the March editorial, "The Market for Plastics in Building." Most of the professionals in the building industry are well aware of the situations which must be overcome both within your industry and in their own before plastics are accepted and used in the extensive manner that your industry anticipates.

The varying characteristics of plastics present separate problems whenever a new product is developed that is entirely dictated by the service expected of that product. Thus, I believe that the plastic components of that product must be designed specifically for the functions expected.

Where one product might require strength as its primary characteristic, the other may demand flexibility, while the third might have appearance and durable surfacing as its basic need. Thus, I can understand the burden placed upon the manufacturers, not only the raw material, but the assembly of plastic parts in a product that is composed of other materials as well.

Within the building industry, the builder is a very cautious man in accepting new ideas and materials.

The third element with which your industry must contend, as you so rightly state, involves building codes and also the attitude of labor towards the adoption of new materials. To make progress in these two areas, it will take much patience and education.

I most sincerely believe that you have presented the case factually and frankly to your industry.

J. M. Lange, Exec. Editor & Vice President,
PRACTICAL BUILDER
Chicago, Ill.

We invite letters from our readers for publication in these columns. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation and address.

A letter will not be printed if publication is not desired by the sender, and the identity of the writer will be withheld, if desired.

—The Editor

In the Next Issue

The June issue will feature the following articles:

Post-Molding Operations on Acetal Resins. R. L. Miller, Sales Technologist, Polychemicals Dept., E. I. du Pont de Nemours & Co., Wilmington, Del.

Because of its combination of mechanical properties, Delrin acetal resin is well suited for machining and joining (by welding and mechanical fastening) methods in post-molding operations. Machining operations are discussed in terms of recommended tools, tooling speeds, and required coolant use. The discussion of joining by means of welding covers spin welding, hot-plate welding, hot-gas welding, and hot-wire welding. The topic of mechanical fastening includes coverage of press or interference fittings, snap fittings, screwing, nailing, flaring, and cementing.

•

Effects of Secondary Plasticizers on Processing of Vinyls—II. P. D. Sharpe, Senior Technologist, Technical Service, Research & Development, Plasticizers for Rubber & Plastics, Socony Mobil Oil Co., Inc., Brooklyn, N. Y.

The conclusion of a two-part article gives a comprehensive test program and the results obtained showing the advantages and limitations of secondary vinyl plasticizers. Test results cover fusion; compatibility; resistances to extraction in soapy water, gasoline, and oil; volatility; low-temperature flexibility; light stability; migration; odor; color electrical properties; heat stability; flammability; and tensile properties. It is shown that proper blending of plasticizers can give required application properties, and also provide cost savings.

•

Presenting Creep Data on Reinforced Plastics. E. Van Antwerp, Materials Lab., Westinghouse Electric Corp., East Pittsburgh, Penna.

Two methods for presenting stress-rupture data are discussed and evaluated. Both appear helpful for comparing materials, and depend on the stability of the test laminate at the testing temperature. One method is shown to offer lower testing costs, while providing reliable results.

•

Advances in Phenolic Materials and Processes During 1959. A. P. Landall, Mfg. of Tech. Service Engineering, Chemical Materials Dept., General Electric Co., Pittsfield, Mass.

The second in the 1960 series on Advances in the Technology of Plastics.

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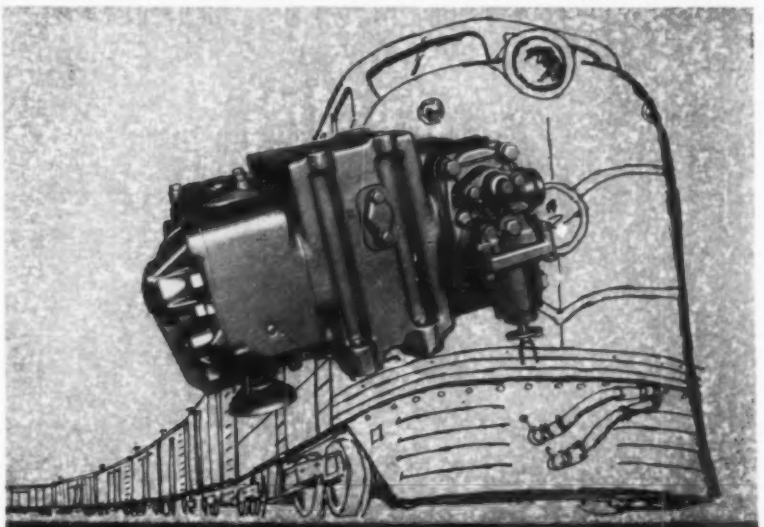

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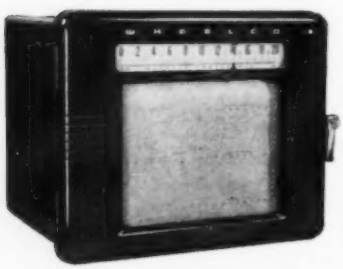

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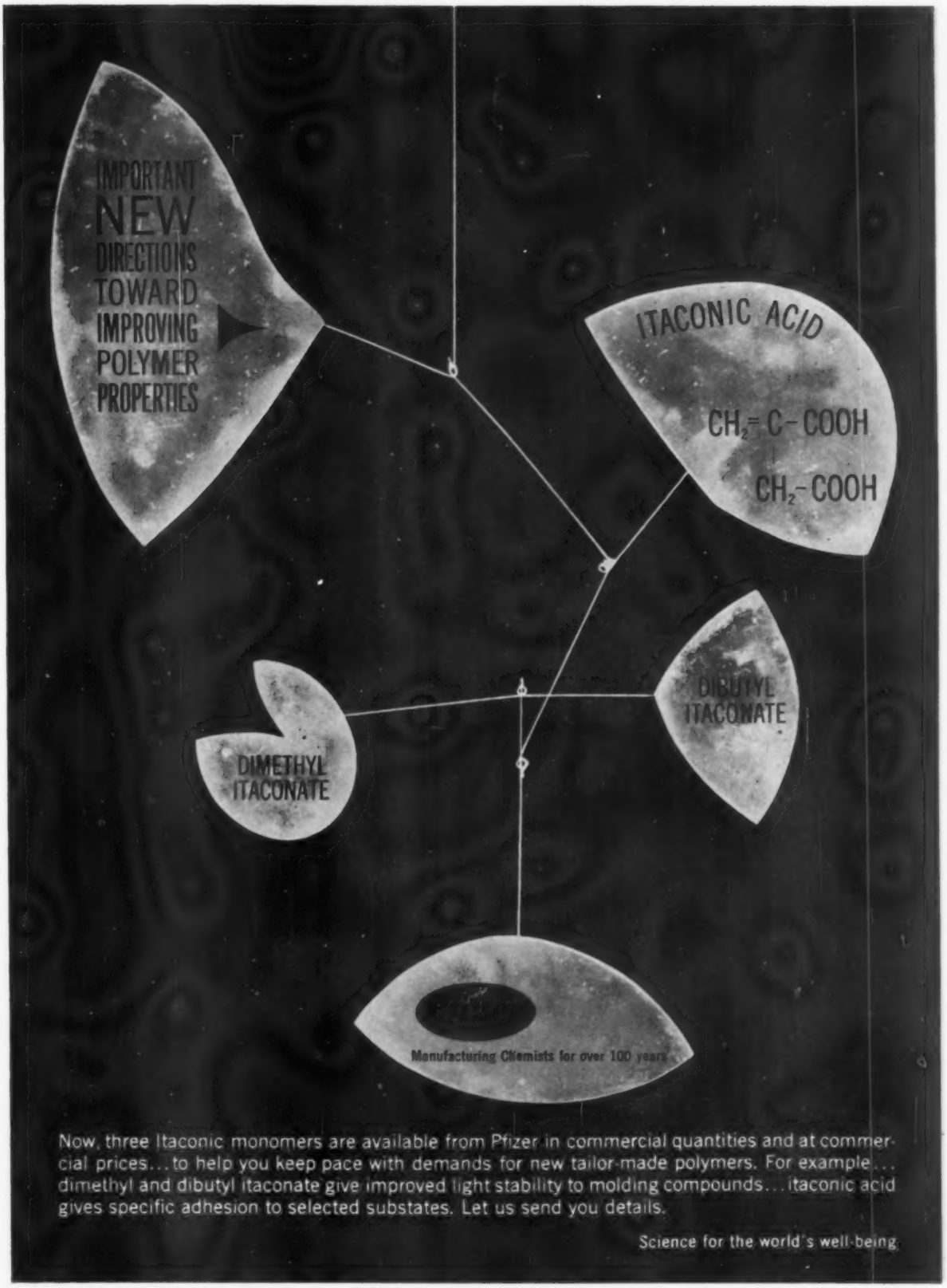
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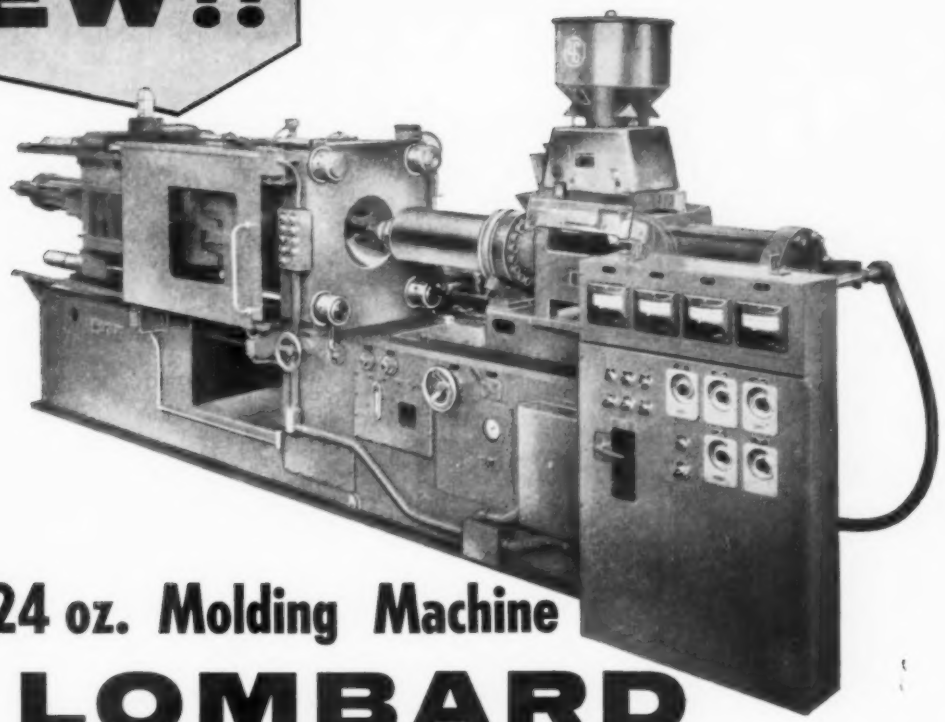

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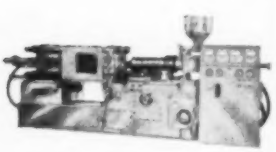

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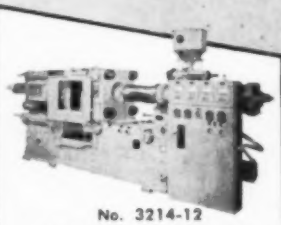

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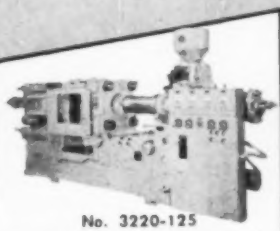

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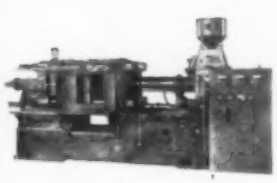

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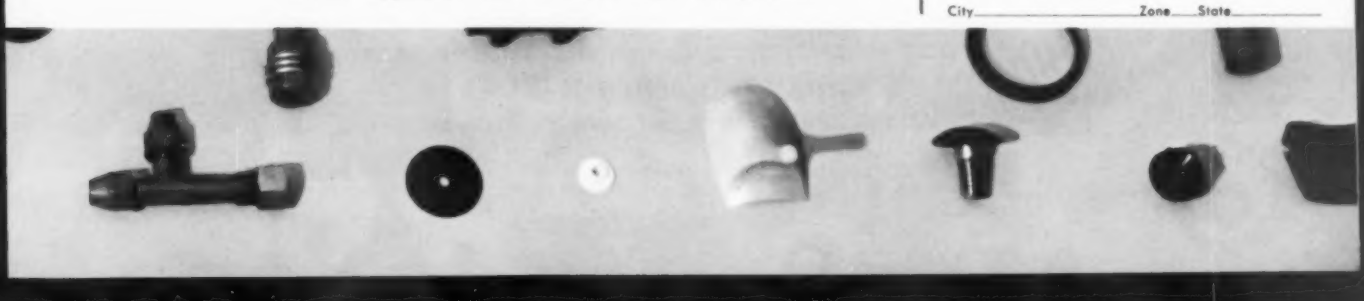

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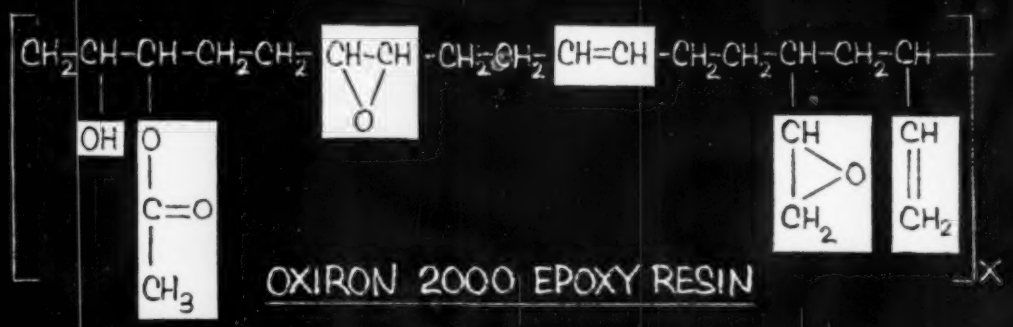

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OXIRON Epoxy Resins Offer Multiple Reaction Sites Plus Unique Vinyl Reactivity

OXIRON 2000 Series Resins are Highly Reactive.

The unusual molecule of FMC OXIRON Resins affords *10 or more* reaction sites. They can be cured through reactive double bonds as well as epoxy and hydroxyl groups. Multiple epoxy groups are located at external positions and internally along the hydrocarbon backbone.

Unlike conventional epichlorohydrin epoxies, OXIRON Resins are epoxidized polyolefins. Because of their unusual combination of properties, they offer many new application possibilities.

OXIRON Resins Offer the Following Advantages:

Novel Cure: Can be peroxide cured through reactive double bonds as well as with conventional epoxy curing agents–high reactivity with anhydrides and dibasic acids at low temperature– increased pot life with polyamine cures–reactive with a wide variety of other curing agents, e.g., polyphenols, Lewis-type catalysts, polysulfides.

Economy: Low-cost curing agents may be used in high proportions.

Low Density: 20% lighter than ordinary epoxies–cured resins likewise have lower density.

Outstanding Chemical and Electrical Resistance: Excellent resistance to alkalis, acids, and solvents –cured resins have good electrical properties.

Superior High Temperature Performance: Combination peroxide and anhydride cures give high heat distortion point resins. The unique flatness of the heat distortion curves of OXIRON Resins translates to acceptability for practical use at temperatures ranging far above the heat distortion point itself. OXIRON Resins show superior high temperature aging.

Send for our *FMC Epoxy Data Booklet* which describes OXIRON 2000, 2001 and 2002 in detail, contains curing information and gives suggested uses. After deciding which resin will best suit your needs, we will supply laboratory samples upon request.

fmc FOOD MACHINERY AND CHEMICAL CORPORATION

Epoxy Department (PT-5)

161 East 42nd Street, New York 17, N. Y.

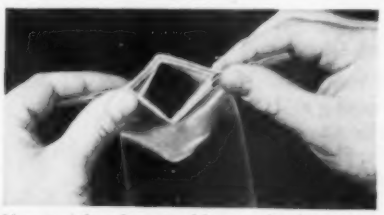
U.S.I. POLYETHYLENE NEWS

A series of advertisements for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

MAY, 1960 — U. S. Industrial Chemicals Co., Division of National Distillers and Chemical Corporation — 99 Park Ave., N. Y. 16, N. Y.

Packaging Notes

A low-cost sterile polyethylene bag with a wire closure is now being used by the dairy industry for milk sampling and is reportedly finding application in a number of markets including frozen foods and cosmetics. In dairy use, the bags are said to reduce sampling costs up to 50% through replacement of bulky glass containers and elimination of washing, sterilizing and breakage.



New container is opened by pressing in on wire tape. A liquid-tight seal is formed by pulling tape taut, rolling top of bag and folding wire ends together.

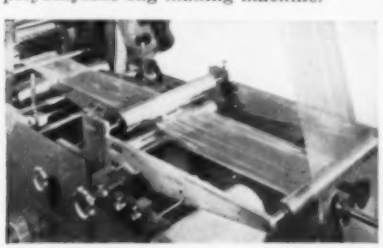
The containers are made of clear, heavy polyethylene tubing, sealed at both top and bottom to keep the inside sterile. A line of perforations is provided for removing the sealed top. Below the perforations are two wires which make it possible to open or shut the bag without touching the sterile opening. The bag is resealed with the aid of the wires, which are bent to form a liquid-tight closure.

A newly introduced gusseting attachment for polyethylene bag-making machines now permits converting flat polyethylene tubing into gusseted tubing without the use of an air bubble.

The new unit permits printing and perforating of flat tubing before gusseting. Among the advantages claimed for this method of converting are improved printing quality, the possibility of printing on one half of the gussets of seamless bags, and placement of perforations within the gussets—without impairing the printed face of bags.

It is also reported that the unit eliminates telescoping rolls and overcomes any tendency of the film to block. Fewer roll changes are necessary, too, because flat tubing gives more footage than gusseted tubing on the same diameter roll. Attendant problems of winding up gusseted rolls are avoided.

The manufacturer reportedly offers complete gusseter kits for any model of polyethylene bag-making machine.



Gusseter attachment for bag-making machines permits converting flat polyethylene tubing into gusseted tubing without the use of an air bubble.

New U.S.I. Resin Produces Film With High Strength, Superior Appearance

Tailored for Produce Bags, New General Purpose Resin to Find Other Uses Where Combined Gloss, Clarity, and Strength Are Needed

The U.S.I. Polymer Service Laboratory has developed a new film-grade resin for producing polyethylene film with maximum clarity and gloss in combination with high impact strength. While the new resin—designated PETROTHENE 112—is tailored for the produce bag market, it should also find application in many other markets where combined gloss, clarity, and strength are desirable film properties.

Melt Index, gms/10 min.	3.0
Density, gms/cu. cm.	.921
Transmittance, %	65
Gloss, %	12
Haze, %	5
Dart Drop gm./F50	210
Draw Down, ft/min	330

Except for drawdown, properties of PETROTHENE 112 were determined on 1.5-mil blown tubing extruded at 330° F. stock temperature on 1½" MPM with 20/1 L/D ratio.

Special synthesis conditions during manufacture give the new resin outstanding flow properties which permit rapid extrusion of film. High drawdown rate of the resin makes it possible to extrude PETROTHENE 112 into thin gauge film without hot snap-offs. In preliminary tests, heat sealability of films made of the new resin was shown to be good under a wide variety of heat and pressure conditions. Treatment of the film for printability has also been accomplished with good results at commercial haul-off rates.

Recommended Extrusion Conditions

For peak gloss and clarity, PETROTHENE 112 should be extruded at about 330° F. stock temperature with a minimum blow ratio greater than 2 to 1.

PETROTHENE 112 is available in low-, medium- and high-slip formulations and in the no-slip form. A technical data sheet on this new resin may be obtained by writing to the Technical Literature Dept., U.S. Industrial Chemicals Co., or any of U.S.I.'s sales offices.

National Distillers' Annual Report is Polyethylene Coated

Cover stock for National Distillers and Chemical Corporation's recently issued 1959 Annual Report is extrusion coated with a protective layer of polyethylene. Advantages of using the polyethylene coating include durability, high gloss finish, and protection of the cover against tearing and soiling. The polyethylene coating also adds to the attractive appearance of the report.

National Distillers' 1959 Annual Report is the Company's third annual report to have a polyethylene coated cover. Pellets of PETROTHENE 203-2 polyethylene resin, the coating resin used, are also shown.

In producing the cover, ten-point cover stock was first gravure printed. The printed roll was then extrusion-coated with PETROTHENE 203-2 resin.

The sheeted covers were next printed on the reverse side by letterpress with rubber plates, then the cover was embossed and stamped with gold leaf.

National Distillers and Chemical Corporation has successfully used tough, clear polyethylene coatings for its annual report for the last three years. The company foresees a growing use of polyethylene coating for publication covers, both for the feeling of quality they impart as well as for their durability.

High Greaseproofness Feature of New Coating Resin

U.S.I. has introduced a new polyethylene coating resin which reaches 100% passage of Military Specification MIL-B-121B for greaseproofness at a lower coating weight than other resins of similar melt index and density. The new resin—PETROTHENE 205-15 with a density of 0.924 and a melt index of 3.0—has excellent adhesion with a wide variety of porous and non-porous substrates.

The flow characteristics of PETROTHENE 205-15 are well suited for high-speed extrusion coating. Coatings as thin as 0.5-mil can easily be applied. Neck-in, which results in costly trim loss, is reduced to a minimum. Polymer build-up at the die is virtually eliminated. According to U.S.I. Polymer Service Laboratories, maximum polyethylene to substrate bond strength is achieved at melt temperatures of 575° F. and higher.

PETROTHENE 205-15 is unique in that it offers the wide heat-sealing range normally associated with a low-density resin, combined with high greaseproofness usually associated with higher density resins. A technical data sheet on this new coating resin may be obtained by writing to the Technical Literature Dept., U. S. Industrial Chemicals Co.

U.S.I.

Series V, No. 3

POLYETHYLENE PROCESSING TIPS

FACTORS AFFECTING ADHESION IN EXTRUSION COATING

In the polyethylene extrusion coating process, the nature of the bond between coating and substrate can be chemical, physical or a combination of both. Chemical bonding is involved almost exclusively when the substrate is a non-porous material such as foil or cellophane. With porous substrates such as paper or board stock, physical as well as chemical bonding takes place.

Physical bonding results from the absorption of the molten polymer by the substrate pores. The degree of adhesion is primarily a function of the polyethylene melt index and the surface characteristics of the substrate.

Resins of lower viscosity, which flow more freely, bond more firmly than do higher viscosity resins. The more porous the substrate, too, the better the physical bond will be.

Oxidation Improves Chemical Bonding

Chemical bonding depends on the number of carbonyl (CO) groups on the coating surface at the moment of contact with the substrate. Since carbonyl groups are formed by oxidation of the polymer, conditions which promote oxidation generally result in improved adhesion.

Heat has the greatest effect on oxidation; hence, stock temperature control is important. Figure 1 shows that increasing stock temperature produces an increase in carbonyl groups on the polymer surface. Figure 2, the curve showing the effect of stock temperature on adhesion, is almost identical.

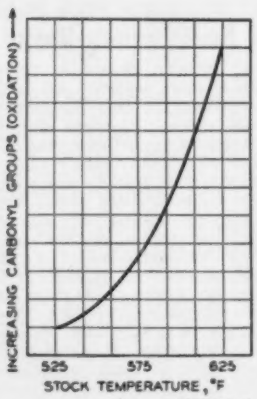


FIGURE 1

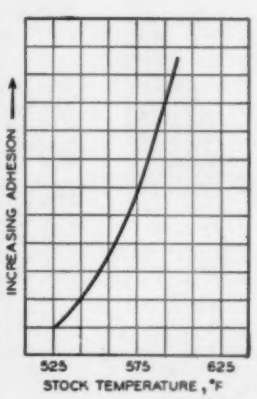


FIGURE 2

A minimum stock temperature of 575°F. is necessary for adequate adhesion in most operations. This value is based on extensive research in the Polymer Service Laboratories of U.S.I. As a rule, temperatures above this are recommended.

The operator, however, must not work at temperatures high enough to cause excessive oxidation. If he does, the polymer will be degraded badly and its heat sealability impaired. Using the above minimum value as a guide, he must determine for each application a stock temperature that will give maximum adhesion without serious degradation.

Controlling Coating Temperature

Several other operating variables affect oxidation of the polymer. Increasing the coating speed allows less time for oxidation to occur, and therefore decreases adhesion. Conversely, heavier coating weights improve adhesion by slowing the cooling time of the molten web. Preheating the substrate has the same effect.

Adjusting Coating Equipment

One measure of coating quality is uniformity of adhesion across the entire width of the substrate. This can be achieved only by careful alignment of the extrusion coating equipment. Chill and nip rolls must be parallel in the same horizontal plane, and the die must be in a plane parallel to the nip.

Pressure applied by the rubber pressure roll should be uniform across its width. And excessive pressure should be avoided since it contributes little to bond strength.

Picking the Right Resin

Good adhesion also depends on the choice of the right resins. Many resins that are excellent for film extrusion, for example, are not quite so good for extrusion coating. U.S.I. has developed the following series of "Petrothene"® resins specifically for the coating process. These resins have excellent coating characteristics and their oxidation is easy to control.

PETROTHENE® Resin	Melt Index	Density	Recommended Coating Weight (Lbs. per 3000 sq. ft.)
200-2	3.0	0.915	20 and higher
201-2	5.0	0.915	10 to 25
203-2	8.0	0.915	3 to 15

U.S.I. Technical Service Engineers are ready to help you select the best resin and operating conditions for your application. Just give us a call.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York 16, N. Y.
Branches in principal cities

NUODEX NUOCURE 28

A new certified catalyst for flexible urethane foams

combines
exceptional stability
with
predictable reproducibility
to control
uniformity in foaming

Nuodex Nuocure 28 is a new stannous catalyst designed specifically to improve the characteristics of one-shot urethane foams. A clear liquid, Nuocure 28 has proved a demonstrable ability to produce improved uniformity in foams which, in turn, results in superior resistance to heat and oxidation. It is exceptionally stable and has extended effectiveness in use.

As all other Nuodex chemicals for the plastic industry, the *stannous content* of Nuocure 28 is *certified* to assure you of consistent, reproducible results time after time.

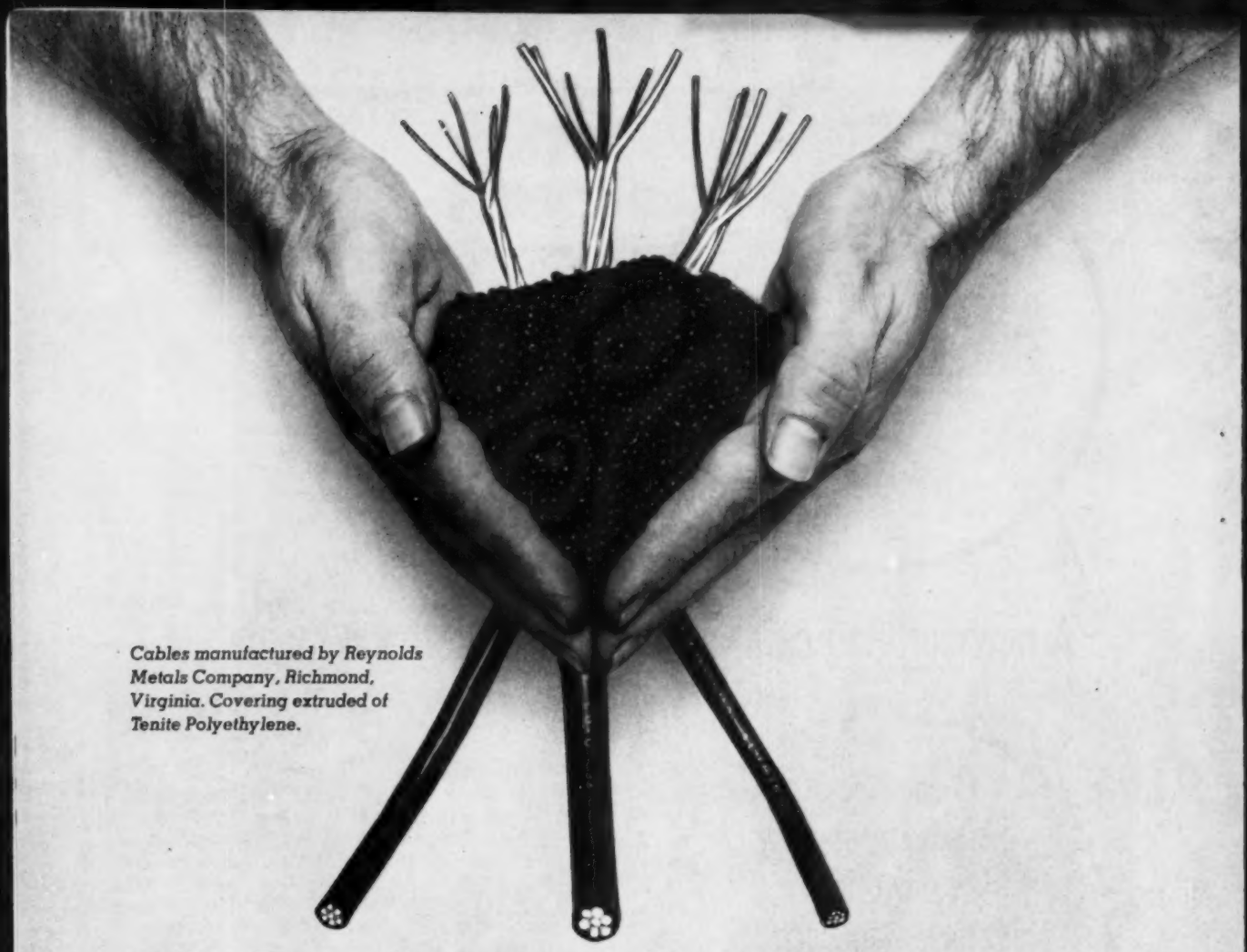
Let Nuocure 28 prove its superior catalytic action in your foams. Send for a sample and application data, then compare the results.

NUODEX special purpose chemicals for industry

NUODEX PRODUCTS COMPANY • ELIZABETH, NEW JERSEY

A Division of Heyden Newport Chemical Corporation

Fungicides • Nickel Salts • Organic Peroxides • Paint Additives • Stearates • Vinyl Additives



Cables manufactured by Reynolds Metals Company, Richmond, Virginia. Covering extruded of Tenite Polyethylene.

Why Reynolds covers these aluminum conductors with TENITE POLYETHYLENE

To obtain the highest possible performance from their secondary distribution and service line cables, Reynolds Metals Company chooses Tenite Polyethylene as a covering material.

Tenite Polyethylene is manufactured under as rigid a system of quality control as Reynolds' own aluminum conductors, and makes a tough, weatherproof, fast-stripping covering material which offers high dielectric strength and resistance to abrasion, heat, moisture, chemical attack and stress cracking. It remains flexible even at sub-zero temperatures and its light weight permits easy handling and wide spans. Users report that it gives long service life without festooning or splitting.

Tenite Polyethylene is easily extruded as jacketing or insulation for many diverse applications, from coaxials to control cables, from TV lead-ins to telephone wires. For a material with outstanding electrical, physical and chemical properties, specify Tenite Polyethylene. For further information, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

Both natural and black electrical grade Tenite Polyethylene are available to cable manufacturers in a unique spherical pellet form which flows freely in the extrusion process and in "air-veying" of bulk shipments from truck to bin.

TENITE®
POLYETHYLENE
an Eastman plastic

3 WAY SAVINGS

WITH D-M-E STANDARD MOLD BASES

1 ADDED QUALITY

Exclusive design features provide extra-cost construction at standard prices! You get first-quality carbon or alloy steel, all surfaces ground flat and square, plus these features offered only by D-M-E: Patented tubular dowel construction; one-piece ejector housing; stop pins welded to ejector bar; sizes to 23¾" x 35½"; and the assurance that every D-M-E product is inspected *by the most modern methods and equipment.*

2 GREATER ECONOMY

Interchangeability lets you replace *any* component without special fitting or re-working! What's more, you can select from the widest range of Standard Mold Bases available anywhere—over 7,000 cataloged combinations.

3 FASTER SERVICE

Delivery from local stock means you get Standard Mold Bases, components and moldmakers' supplies when you need them —direct from D-M-E's fully-stocked local branches!

ARE YOU GETTING THE NEWS?

D-M-E's monthly publication is full of cost-saving ideas for designers, moldmakers and molders. Write on your letterhead—we'll place your name on the "NEWS" mailing list. No cost, no obligation.

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YOU NEVER MADE SO MUCH BEFORE !

Now, a superior way to increase the production and profits from compression or transfer molding presses

Thermall Preheaters are used by most compression and transfer molders. The reasons are simple! Thermall Preheaters (available in either standard or automatic models) not only represent a lower initial investment but also give superior performance. And superior performance means **increasing your production** while **decreasing your production costs.**

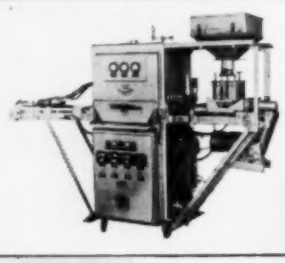
Because of its superior design, a Thermall Preheater will heat loose powder or preforms uniformly, quickly and economically and will give you day in and day out performance, around the clock, with the absolute minimum of maintenance.

With a Thermall you will get a reduction in rejects, be able to mold larger parts and increase production as much as 200% (such results have been reported from actual jobs).

YOU CAN RENT!

If you find that renting fits in better with your operation – rent one or more Thermall Preheaters.

Don't let another day go by without investigating this proven way to increase your production and profits, contact us now – put a Thermall Preheater in your plant on trial – see for yourself.



AUTOMATIC

AUTOMATIC HOOD

UPRIGHT

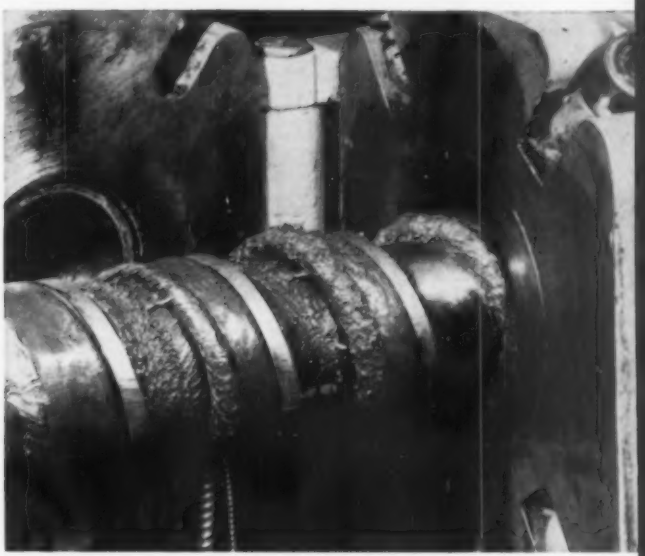
THERMALL

W. T. LaROSE & ASSOC., INC.

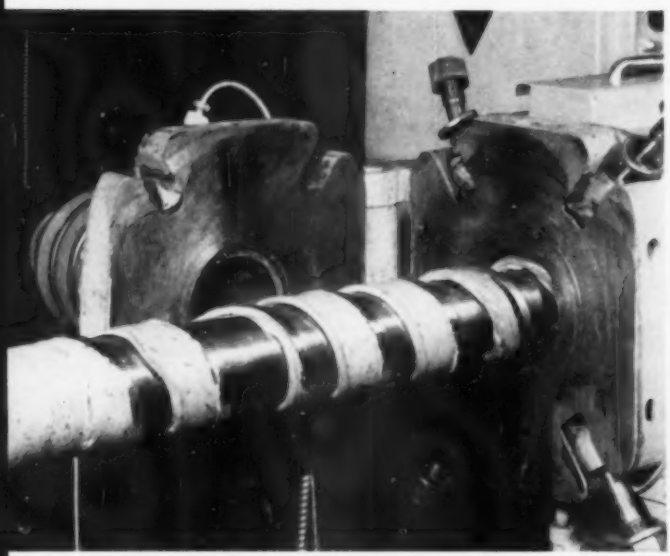
TROY
NEW YORK

now...clean your extrusion or injection machine in hours...not days...with A-C Cleaning Compound

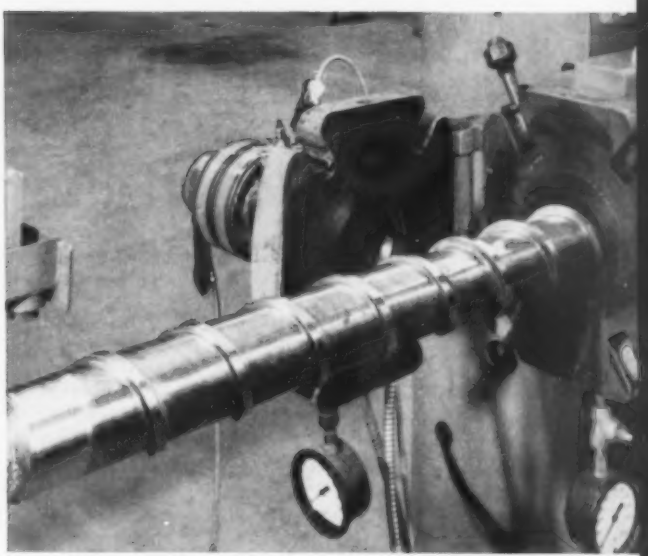
1. Empty hopper and load with A-C Cleaning Compound.



2. Operate machine to purge old material.



3. Note how A-C Cleaning Compound strips off easily.



4. In hours—not days—a clean machine ready for the next run!

If you've been losing days and dollars in making change-overs, here's good news! Allied's Semet-Solvay Petrochemical Division has now developed a cleaning compound that will completely remove any thermoplastic material—and do it in a fraction of the time normally required. The simple procedure is pictured above.

One extruder tells us that he saves $5,000 by using A-C® Cleaning Compound—cleans a machine in 1½ hours without tearing it down.

You'll find A-C Cleaning Compound speeds changing material or colors, and eliminates cylinder contamination. It purges without scratching and strips cleanly and easily from extrusion screws without mess.

For a free bulletin telling how this new cleaning compound can save *you* time and money, just write us at the address below.

Allied Chemical

SEMET-SOLVAY PETROCHEMICAL DIVISION

Dept. 574-R 40 Rector Street, New York 6, N. Y.

National Distribution • Warehousing in Principal Cities

Now... meet the whole **TEMEX*** family!

4 proved stabilizers to improve your vinyl flooring formulations

For a long time now, you've known exactly what you can expect from Temex* 3, National Lead's barium-zinc organic flooring stabilizer with the unique and outstanding chelating action:

- **Superb heat stability**
- **Excellent retention of initial shade of color**
- **Elimination of sulfide staining**
- **Good light stability**
- **No lubricity**
- **High resistance to warping**

Now meet the new members of the family: Temex 3A, Temex 4 and Temex 5. Their characteristics are much the same, but each does some *specific* job particularly well . . .

Take Temex 3A. This one gives better color and gloss to the newer, softer asbestos-filled stocks—the more flexible type that's enjoying such popularity today. Then there's Temex 4, providing non-lubricity and a high measure of heat stability for homogeneous and medium-loaded asbestos tile. And—now the newest member of the family—Temex 5, meeting just about every stabilizer requirement for utility-grade asbestos-filled tile.

Members of the Temex stabilizer group are hard workers. And once flooring is laid, the Temex stabilizer you've chosen continues to preserve the beauty of your product. Against ultra-violet light. Against spillage.

Temex stabilizers are the latest in a long line of outstanding flooring stabilizers developed by National Lead Research. If, for example, you are interested in the newest unfilled vinyl flooring, our stabilizer line has two specialists for this field—Clarite® A and Invin® 91 stabilizers.

Get to know them all. Let them help you improve your formulations ...simplify your processing...boost the life of your vinyl flooring. Full details in National Lead literature available for the asking. Write today.

*Trademark

NLC

National Lead Company, *General Offices:* 111 Broadway, New York 6, N. Y.
In Canada: Canadian Titanium Pigments Limited, 1401 McGill College Avenue, Montreal

KC-6291

Gentlemen: Please send me information on the National Lead stabilizers I have checked:

☐ Temex 3 ☐ Temex 3A ☐ Temex 4 ☐ Temex 5 ☐ Invin 91 ☐ Clarite A

Name_____ Title_____

Firm_____

Street_____

City & Zone_____ State_____

TEMEX* (*stabilizers*)

Chemical Developments of **National Lead Company**

General Offices: 111 Broadway, New York 6, N. Y.

For vinyl plasticizers...

NEW SYLFAT 500*

Direct from Glidden Research Laboratories comes this specially arranged* fatty acid from tall oil with the important properties of vegetable oil fatty acids and the economical advantages of tall oil. It offers:

- **Extraordinary oxirane rating**
- **Highest distillation and epoxy yields**
- **Most economic epoxy reaction**
- **Extremely pale color and stability**

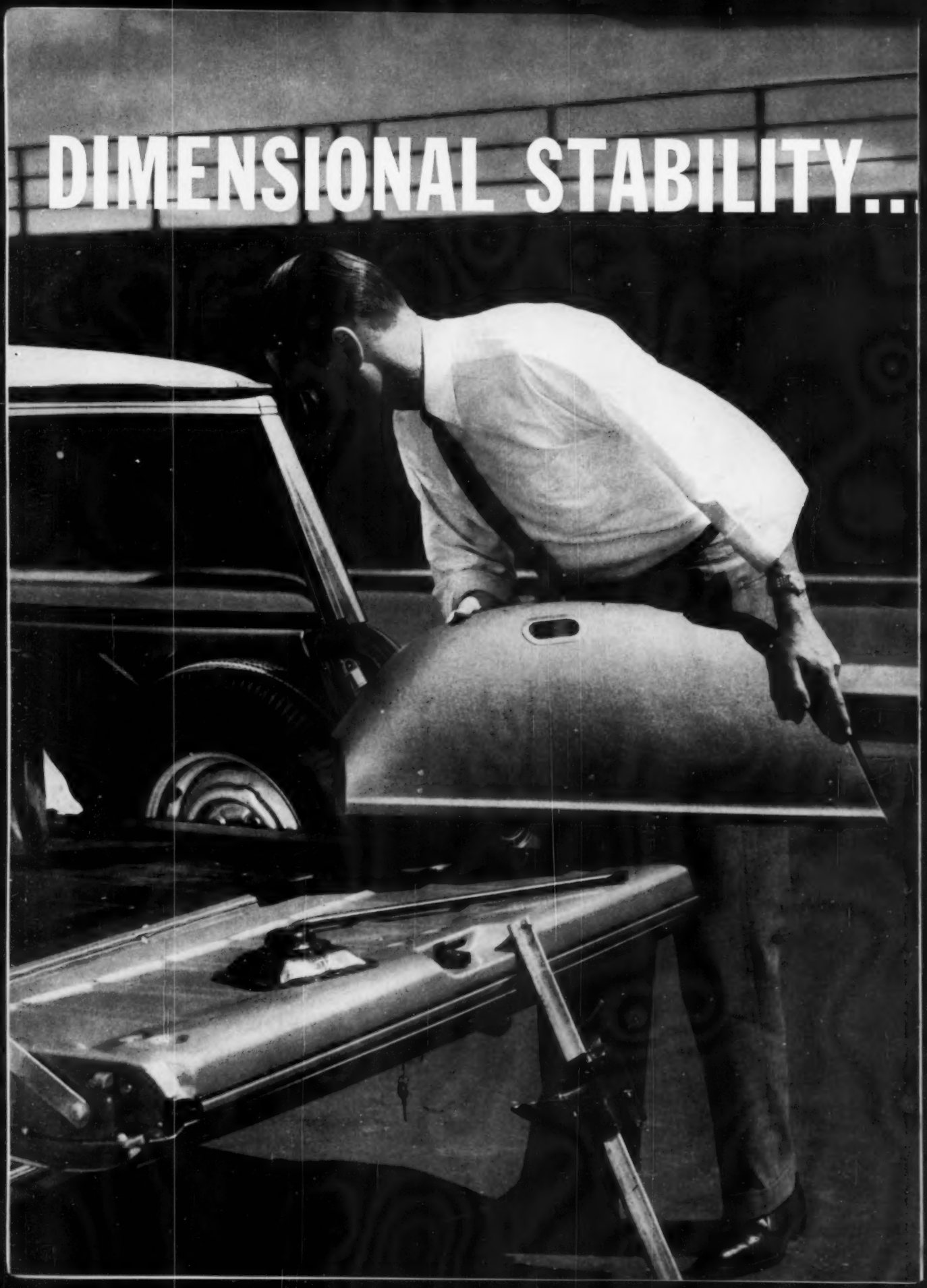
For more complete information and data on this new and latest first from Glidden Research, plus samples, write direct.

* Process patent applied for.

QUALITY Glidden PRODUCTS

THE GLIDDEN COMPANY

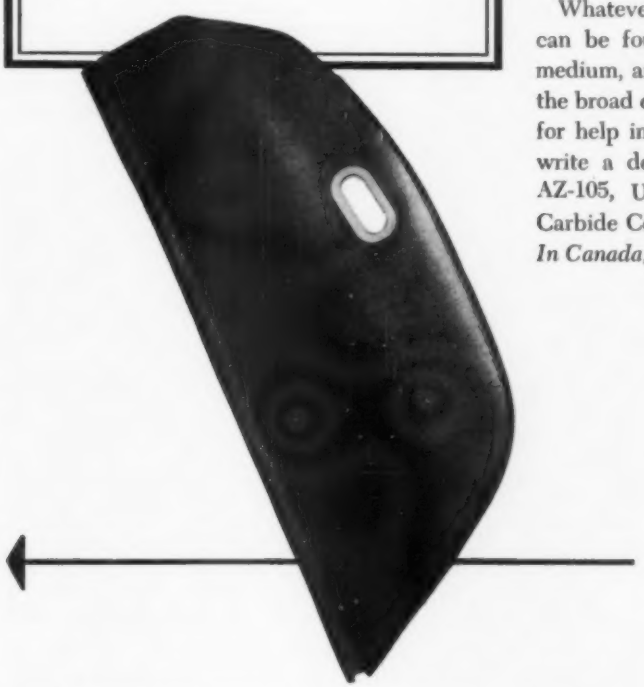
Chemicals Division
Organic Chemical Department
P. O. Box 389, Jacksonville 1, Florida


DIMENSIONAL STABILITY...

...another way high-density polyethylene IMPROVES YOUR PRODUCT

TYPICAL PROPERTIES OF DGDA-3451

Properties	ASTM Test	Typical Value
Density, gm/cc	D 1505	0.960
Melt Index, gm/10 min.	D 1238	0.1–0.3
Tensile Strength, psi	D 638	4200
Elongation, %	D 638	60
Secant Modulus, at 1%, psi	D 638	157,000
Hardness, Durometer "D"	D 676	63
Tensile Impact, ft. lbs./ cu. in.		160



Tough, attractive tire cover demonstrates dimensional stability of products made from BAKELITE Brand High-Density Polyethylene. It is manufactured by Woodall Industries, Inc., Detroit, Michigan for Ford Motor Co., Dearborn, Michigan.

THE FORD MOTOR COMPANY's "Comet" and "Falcon" station wagons are built with some impressive new ideas—combining styling with economy. Even the spare tire gets unusual treatment.

Standing upright, it's hidden by a vacuum-formed cover of BAKELITE Brand high-density polyethylene DGDA-3451. This large part is formed to accurately fit the interior contours of the car. Because of the excellent dimensional stability of BAKELITE Brand High-Density Polyethylene, the tire cover won't shrink, warp, or lose its shape . . . despite rough handling or changing seasonal temperatures.

What's more, this tire cover meets the manufacturer's requirements for attractive appearance. The surface is embossed and the color complements the car's decor. Besides dimensional stability and eye appeal, BAKELITE high-density polyethylene has excellent rigidity, toughness, heat resistance and stress cracking resistance.

Whatever combination of polyethylene properties you need can be found in BAKELITE Brand materials, including low, medium, and high-density polyethylenes. And you can call on the broad experience of Union Carbide in plastics development for help in making your selection. Mail the coupon today, or write a description of your requirements directly to Dept. AZ-105, Union Carbide Plastics Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. *In Canada,* Union Carbide Canada Limited, Toronto 7.

"Bakelite" and "Union Carbide" are registered trade marks of Union Carbide Corporation.

UNION CARBIDE

Dept. AZ-105
Union Carbide Plastics Company
Division of Union Carbide Corporation
30 East 42nd Street, New York 17, N. Y.

Please send me information on BAKELITE Brand high-density polyethylenes with particular emphasis on these properties . . . . . .

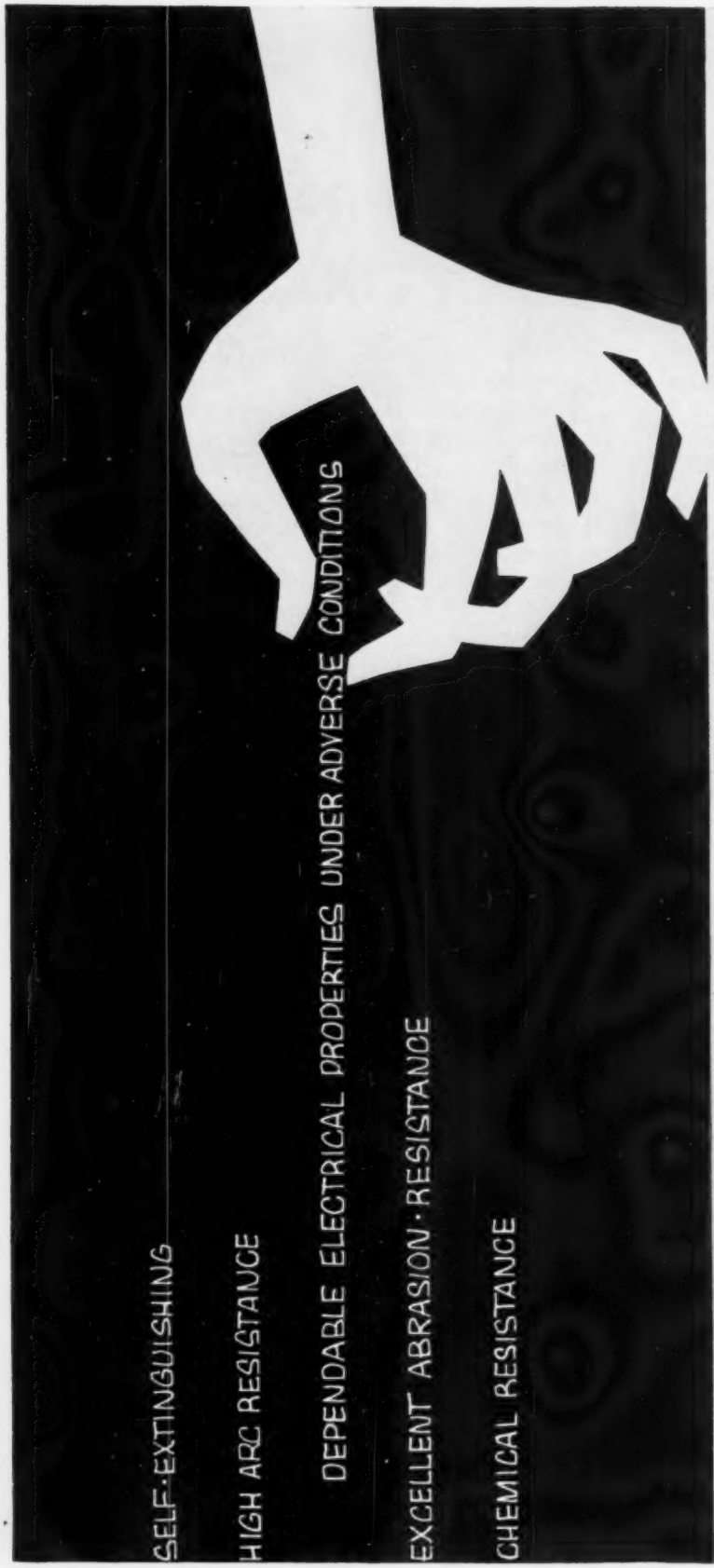
the application being considered is . . . . . .

Name _____

Firm name _____

Street _____

City _____ State _____



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MELAMINE

BEETLE®
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PLASTICS

REMEMBERED FOR PERFORMANCE – CYANAMID MOLDING COMPOUNDS

CYMEL 3135–3136 (glass-filled) Additional distinctive properties: outstanding electrical properties; high impact resistance; extraordinary flame resistance; good dimensional stability. Typical applications: circuit breaker boxes; terminal strips; connectors; coil forms; stand-off insulators. Specifications: Cymel 3135 (MMI-30, MIL-M-14E, Federal L-M-181 Type 8; ASTM D704-55T Type 8); Cymel 3136 (MIL-M-19061, MMI-5).

CYMEL 592 (asbestos-filled) Additional distinctive properties: resistance to atmospheric extremes; high dielectric strength. Typical applications: connector plugs; terminal blocks; a/c, automotive and heavy duty industrial ignition parts. Specifications: MIL-M-14E MME; Federal L-M-181 Type 2; ASTM D704-55T Type 2, SP1 SPEC NO. 27025.

CYMEL 1077 (alpha cellulose-filled) Additional distinctive properties: Surface hardness, heat resistance, unlimited color range. Typical applications: appliance housings, shaver housings, business machine keys. Specifications: MIL-M-14E – Type CMG (in approved colors); Federal L-M-181 Type 1; ASTM D704-55T Type 1, SP1 SPEC NO. 30026.

CYMEL 1500 (wood flour-filled)–CYMEL 1502 (alpha cellulose-filled) Additional distinctive properties: Good insert retention. Typical applications: meter blocks, ignition parts, terminal strips. Specifications: Cymel 1500 (MIL-M-14E Type CMG, Federal L-M-181 Type 6, ASTM D704-55T Type 6); Cymel 1502 (MIL-M-14E Type CMG, Federal L-M-181 Type 7; ASTM D704-55T Type 7.

BEETLE® UREA (alpha-filled) Additional distinctive properties: Economy of fabrication, economy of material, myriad translucent and opaque colors. Typical applications: wiring devices, home circuit breakers, tube bases, appliance housings. Specifications: Federal L-P-406A, LC 726-1, ASTM D705-55, Grade 1 (Arc resistance limits are in process of revision by ASTM), SP1 SPEC NO. 27026.

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Editorial:

1960 Injection Machines & Auxiliaries

Following the format system employed for the past two years, this issue presents a special feature section on 1960 Injection Molding Machines & Auxiliary Equipment.

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The section leads off with a special introductory article, "Matching Injection Molding Equipment for Optimum Performance and Economy," written by Gordon B. Thayer, Plastics Specialist for Dow Chemical's Plastics Technical Service and a respected member of PLASTICS TECHNOLOGY's Editorial Advisory Board. Gordon's article makes a worthy follow-up to his previous articles on injection machines and auxiliary equipment. This, coupled with his fame and well-earned reputation in the field, warrants placing his current article in the "must" category for our readers—don't you agree?

Next in the special section is a comprehensive tabulation, PT's Comparative Data on 1960 Injection Molding Machines. The need for our coverage of these machines arose from the many new models developed since our 1959 tabulation that appeared in our May 1959 issue. This previous tabulation, and its predecessor on 1958 machines, won wide acclaim as needed and outstanding jobs, with thousands of reprints being ordered by the machine manufacturers and the entire gamut of plastics companies represented by our readership.

An important point to be noted is the retention this year of the data categories used in the 1959 tabulation. This retention illustrates the excellent progress made by injection machine manufacturers in achieving a major degree of standardization in important specification features.

Again, as was the case last year, we have limited the machine manufacturer to not more than six models in the tabulation, thus avoiding use of oversize pages in the magazine. Companies having more than six machinery models have been footnoted accordingly in the tabulation—please note!

The special section concludes with a lengthy listing, PT's Classified List of Auxiliary Equipment. This listing has been greatly expanded from last year, and the headings have been reorganized and improved.

Summing up, we have endeavored to have the special section deal with all equipment items of interest and value to anyone contemplating the injection molding of plastics. Is there anything else that can or should be added to future special sections to make them more comprehensive and valuable?

•

The third 1960 special issue will appear in September, and will feature a special section dealing with 1960 Extrusion and Blow Molding Machines. Here, again, emphasis will be placed on auxiliary equipment, and there will be comprehensive data tabulations that will show marked improvement over those published last year.

As in the past, your comments are invited on this issue; the past February issue dealing with Compression and/or Transfer Molding Machines and Thermoforming Machines; and the coming September issue on Extrusion and Blow Molding Machines.

Question: Is there any other plastics processing machine category that should be added to our line-up of special issues?

Arthur M. Merrill

Editor

This Month In Brief

1960 Injection Molding Machines & Auxiliary Equipment. This is the second special issue this year in the series dealing with the different classes of plastics processing machinery (the first was the February issue, and the next "special" will appear in September). As explained in the Editorial, this issue's special section begins with an invited introductory article; follows with an involved tabulation on new and current injection machines; and concludes with a lengthy classified list of auxiliary equipment available from domestic suppliers. Finally, the Editorial asks the readers if we have omitted any important machine classification from our series.

The Guest Editorial this month describes instrumentation seen at the 1959 Dusseldorf plastics exhibition, and compares them with U.S. styles. In general, European instrumentation is more simple, and is designed to meet less-sophisticated needs in plastics processing.

Improved Fastening Devices for plastic parts are discussed in the engineering section, Exploring Fabrication Techniques, in this issue. The problems and dangers involved with the use of inserts during manufacture are pointed out, as well as their advantages and limitations in part design and usage.

Some notes on the Technical Articles in this issue follow:

The lead article, "Multi-Gating Techniques for High-Density Polyethylene," describes mold constructions that can be used advantageously for injection molding of this material.

"Effects of Secondary Plasticizers on Processing of Vinyls - I" is the first section of a two-part article that shows how plasticizers can be blended to meet application requirements at lowest possible costs.

"Production Processes for Gel-Coated Glass-Polyester Plumbing Fixtures" is a comprehensive discussion of gel-coat formulations, molding processes, and design requirements that can be modified to suit other gel-coated glass-polyester applications.

"Matching Injection Molding Equipment for Optimum Performance and Economy" - the introductory article for the special section on injection molding - stresses that auxiliary equipment must be engineered into the production cycle in order to obtain satisfactory results.

Two Engineering Forum columns in this issue: Compression & Transfer Molding; and Reinforced Plastics. The first gives another look at compression molding pressures and how they can be determined. Special attention is directed at the chart on empirical molding pressures for soft and hard flow thermoset materials. The second Forum deals with new horizons for r-p usages, and mentions some that may appear far-fetched at this time, but are in the planning stage right now.

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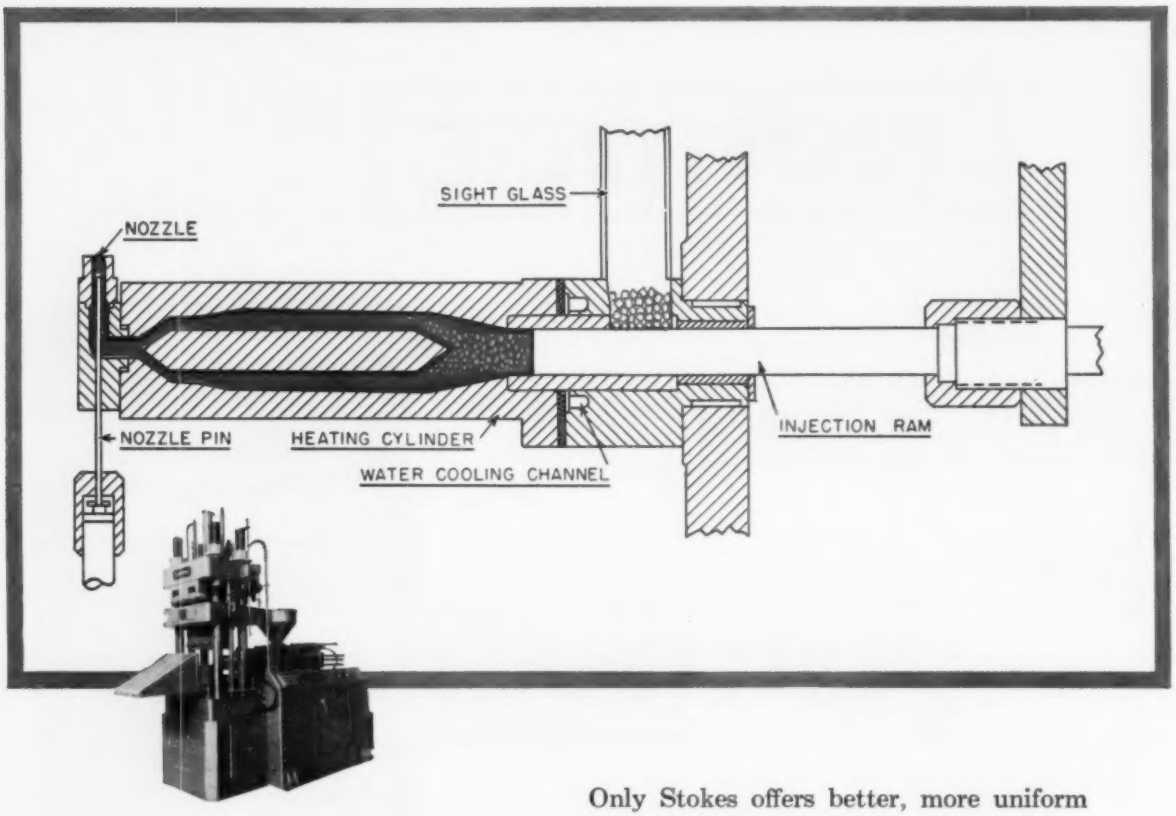

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- ACETATE molding compounds
- ACETATE sheeting
- POLYESTER resins

CELANESE TECHNICAL SERVICE

How to put more experts on your team without extra cost

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EQUIPMENT AND ITS ADAPTATION

Celanese Technical Service will be glad to discuss your equipment requirements or needed modifications. For example, you may benefit from their knowledge of auxiliary molding equipment, or cooling processes, or the details of molding machinery.

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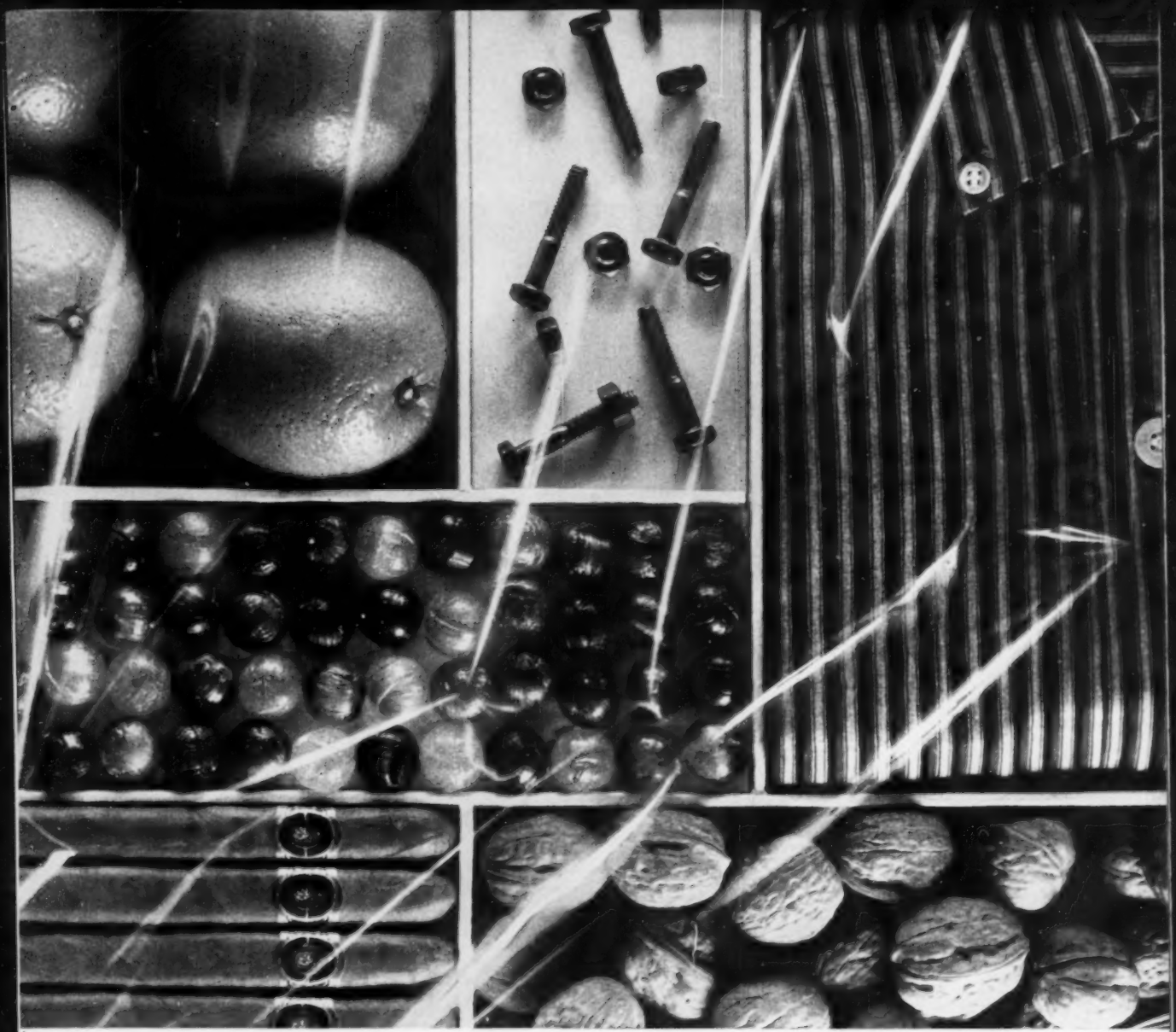

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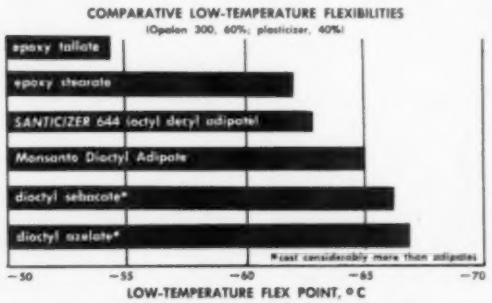

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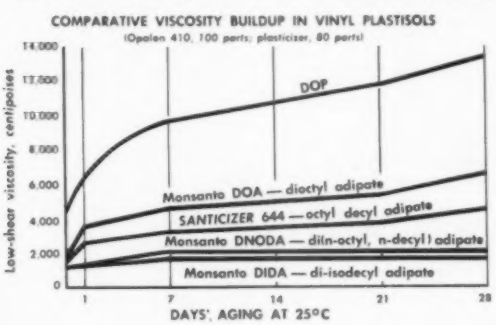

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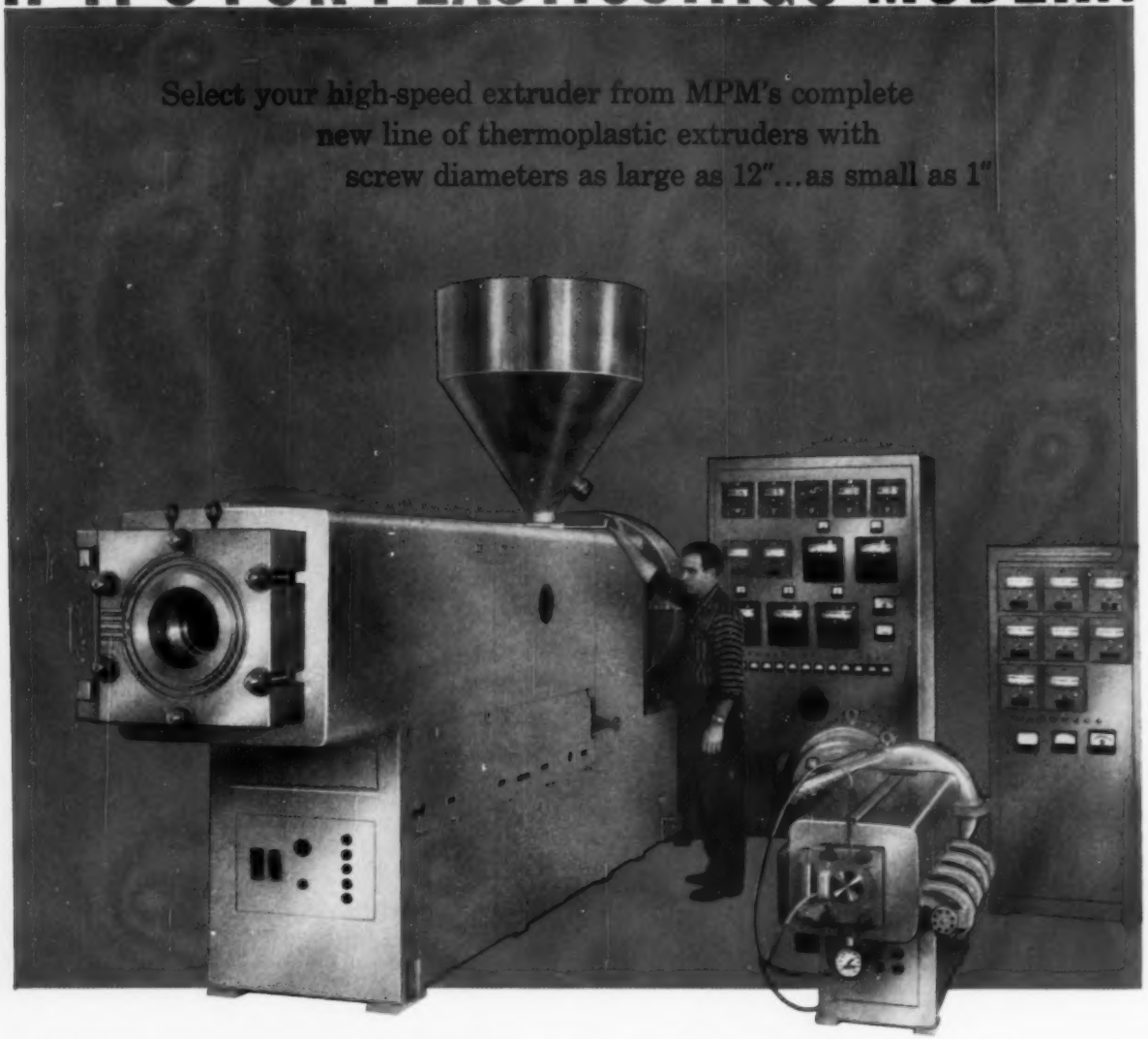
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What's new in processing

Cut-outs, perforations, and decorative patterns can be produced in plastic sheets by a Swedish process which requires no subsequent stamping, trimming, or punching. The method consists of spreading a plastic liquid or paste, by brush or roller, over a stencil. The plastic passes through onto a non-adhering metal, paper, or other support. Heating evaporates the solvent and effects gelation or polymerization of the resin. The sheet, as it leaves the support, is said to require no further finishing.

Dr. Herbert A. Pohl of Princeton University's Plastics Laboratory has developed a method of separating mixtures of particles by electricity. The degree of pull exercised by electrical fields is affected directly by the dielectric constant of any given material. Dr. Pohl's apparatus is about finger size and requires but one millionth of a watt of power for operation. It can handle about one gram of powder per minute. Called an isomotive cell, the mechanism can cause organic fluids to spout 4-6 feet and cause droplets to hang in space or travel in satellite-like orbits around an electrode. Powders suspended in non-conducting liquids like benzene can be made to precipitate onto electrodes or disperse violently. Plastics applications were not revealed, but can be readily conjectured.

High-production color decoration of many mass-produced plastic items will be possible due to new vertical fixtures developed by Conforming Matrix Corp. The device employs a square shaft air cylinder to assure positive registration of the part onto the mask. The fixture revolves 360° on bearings for greatest ease in painting.

Hydrocarbon solvents can be removed from plastics by direct-heat rotary drying with super-heated solvent vapors, a process developed by the Process Equipment division of Standard Steel Corp. Advantages include: a more efficient and economical solvent recovery system, lower initial cost through direct heat drying, and lack of metal heat-transfer surfaces with subsequent decomposing and contamination. Heated solvent vapors enter the dryer to act as a heat vehicle, leave to go into a primary cyclone, and then pass through a cloth-type filter or wet solvent scrubber to remove fines. Some solvent is removed at this point and recovered; the rest passing through a steam-jacketed heat exchanger for recycling.

Abstracts

"Tumbling Thermoplastics" was described by Joseph Ashmore in the March issue of Modern Plastics. Customarily associated with thermosets, thermoplastic tumbling can be employed to advantage in thermoplastics finishing. Eye-glass temple pieces, acrylic embedments, and Teflon washers can be given a high finish with wood, felt, nut shells, and metals.

"How to Encapsulate with Alkyds" by J. J. Moylan and J. T. Long appears in the same issue as the above. It covers encapsulation both with alkyd putty and with granular material, and covers all current molding practices.

Patents

2,884,337 H. J. Homer and J. R. Whitacre to Commonwealth Engineering Co.—a method of making a metallized transparent tape of cellulose acetate sheet by heating it to 280° F., while moving it lengthwise at a speed of about 15 feet per minute. The sheet passes through a gas plating chamber filled with a flowing stream of nickel carbonyl moving at a speed of 1.8 cubic feet. Nickel is deposited at a uniform thickness, and does not interfere with the sheet's flexibility.

2,885,732 R. W. Kazmaier and Glenn Perry to Libby-Owens-Ford Glass Co.—a method for shaping plastic sheets. Two opposite edges of the sheet are engaged to support it in its original shape in a vertical plane. One non-supported edge is forced perpendicular to the other, to effect the changed shape.

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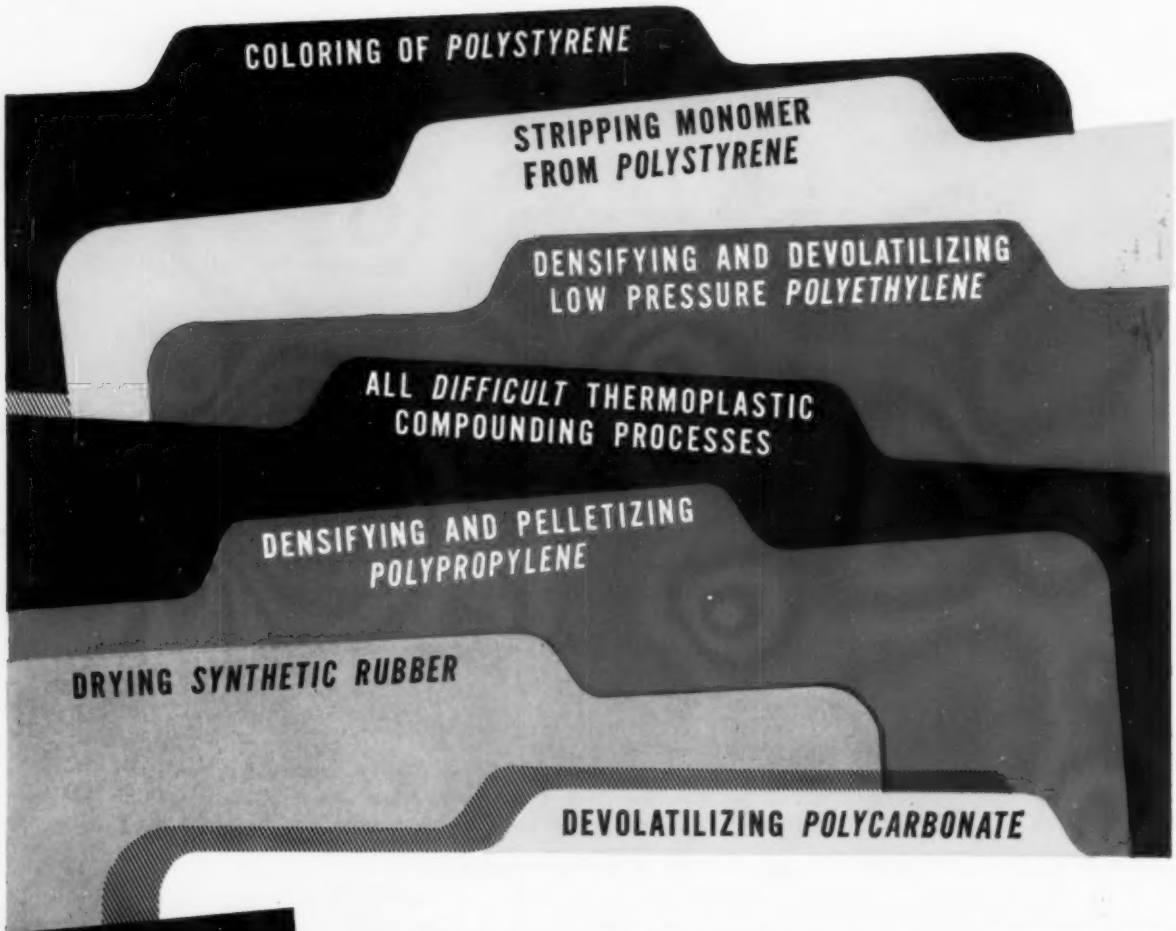

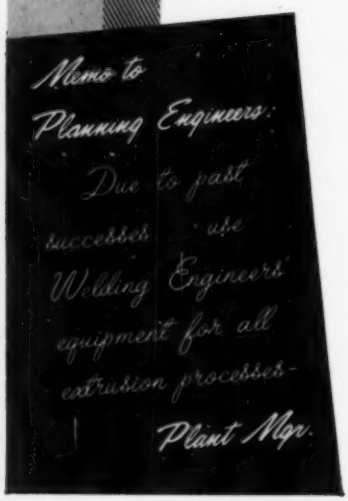
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TECHNOLOGY

Multi-gating techniques for high-density polyethylene

Types of mold constructions which can be used advantageously for injection molding of this material.

by C. L. WEIR

Recent experimental work on the injection molding of linear polyethylenes, both in the raw material manufacturers' laboratories and in the customers' plants, has resulted in new multi-gating developments, useful for molding large items or with multiple-cavity molds.

This paper describes these new techniques so that you may better understand their differences and the advantages to be gained by their use.

Multi-gating a large part is often desirable to obtain rapid fill at lower temperatures and pressures. The principle deficiency of multi-gating is the creation of extra weld lines, and a possible increase in finishing costs. All gates on a multi-gated part should be balanced to obtain uniform fill, with the final welds taking place at the far end of the fill pattern.

A multi-gated part should be so gated that the material will reach a complete shot at about the same time on all parts of the cavity to be filled.

As we become more familiar with the high-density polyethylenes and understand their behavior, especially when molding large items, we realize that instant fill is required—something best accomplished by multi-gating. However, multiple-gating designs effective for other plastic materials do not necessarily work with high-density polyethylene.

Let us consider several approaches to multi-gating a single-cavity mold. In this case, we have chosen arbitrarily a large, single-cavity mold capable of producing an item such as a wash basin or a tote box. With such a mold available, we will then consider the design necessary to gate this part, using: typical three-plate construction; heated torpedoes in multiple nozzles; insulated runner systems; hot-runner techniques; and valve gating (precompressed molding).

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Three-Plate Molds

Standard three-plate mold construction is widely used today in the industry. This is by far the most economical method of achieving either multi-gating of a single cavity, or center-gating of multiple cavities. However, certain disadvantages immediately present themselves. Three-plate molds are cumbersome to operate, and automation is difficult if not impossible. Figure 1 shows our test mold being gated by a typical three-plate set-up.

Where production quantities justify additional cost,

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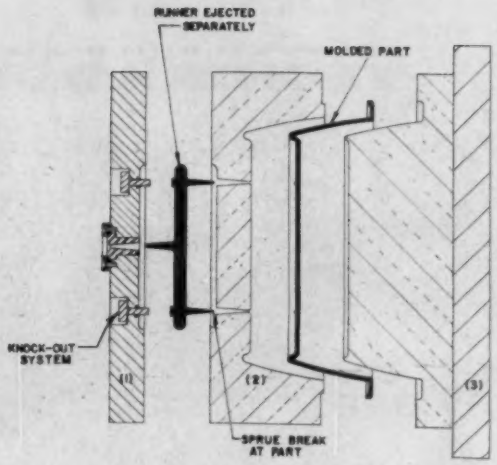

Fig. 1. Cross-sectional view of test mold gated with a typical three-plate runner slide.

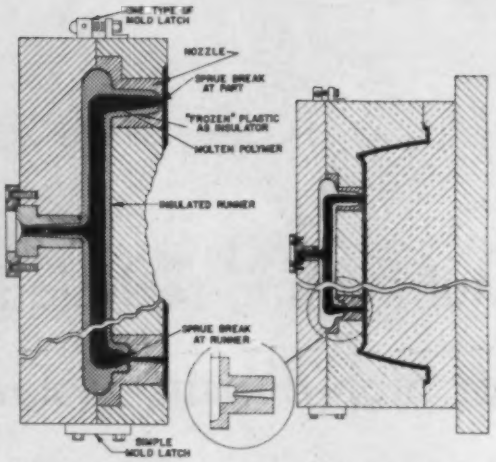

Fig. 3. Cross-sectional view of multiple-gate, insulated-runner molding arrangement.

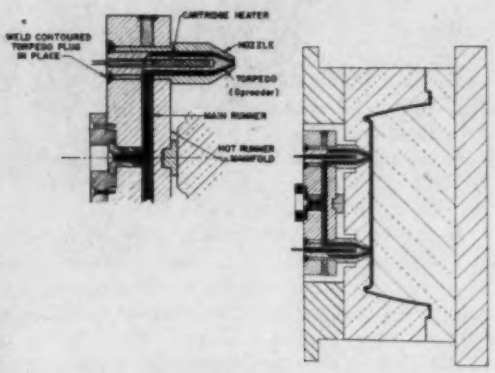

Fig. 2. Cross-sectional view of multiple-nozzle, heated torpedo molding arrangement.

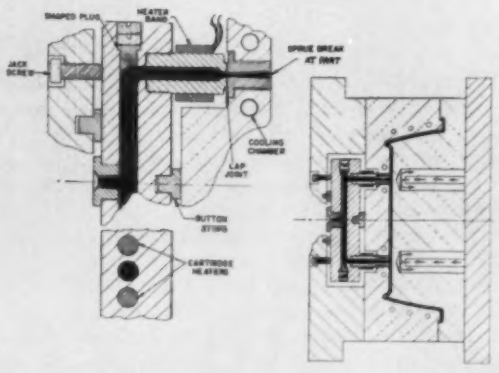

Fig. 4. Cross-sectional view of multiple-gate, hot-runner molding arrangement for making wash basin.

hot-runner systems often are preferred. Automation usually is easy, since no runner system is ejected. This speeds up production and saves the cost of reprocessing material. Major difficulties with hot-runner molds are keeping the runner system near cylinder temperatures, and the gate area cool enough to permit short molding cycles while preventing warpage and gate-brittleness of the molded parts.

Good insulation between the runner system and the mold cavity can eliminate the problems normally associated with hot-runner molds.

Heated-Torpedo Molds

In Figure 2, we see how heated torpedoes in a multiple-nozzle arrangement can be used to mold the same part. Here, we have no runner system to be removed, and have allowed for proper cooling at the cavity wall. Air insulation is required to keep the runner system from transferring its heat mass to the mold base.

Insulated-Runner Molds

Figure 3 shows how an insulated runner can be employed. The part remains the same and the over-all mold construction closely approximates that shown for the three-plate system. A mold incorporating a three-plate design usually can be converted to this type for very little additional cost.

This technique employs the excellent insulating properties of high-density polyethylene to keep the material in the runner system molten and near operating cylinder temperature. Because of the low thermal conductivity and high specific heat of this resin, the center core of a large-diameter runner does not change temperature

significantly during production. This is particularly true if the core is displaced completely by hot resin during each cycle.

This method can be of extreme importance when daylight of a press is at a minimum or the part has a particularly long draw.

As can be seen in Figure 3, two specific types of insulated-runner designs can be employed. Sprue break at the runner allows for better temperature control of the cavity at the gate area, while sprue break at the part eliminates the necessity for a trimming operation.

Hot-Runner Molds

Perhaps the most work has been done using a hot-runner approach. Many mold builders shy away from hot-runner designs because the cost of the mold is increased and because they are not familiar with design practices for high-density polyethylene.

In Figure 4, we show the wash basin gated through a hot-runner system. We strongly recommend that the molded item have the sprues attached when the part is removed from the cavity. The location and size of the gates is very important, and should be determined from the geometry of the part.

As previously mentioned, the manifold must be insulated from the rest of the mold in order to minimize heat loss. This is done by the use of air gaps. The manifold is insulated from the top clamping plate and the cavity retainer plate by using standard "stop pins," and arranging them to support the top and bottom of the manifold. Flat-bottom set screws are used to apply pressure and ensure a good seal between the nozzle and sprue bushing.

Valve-Gating

Such an arrangement also can incorporate the use of valves in the bushings, as shown in Figure 5. When the valves are closed, the injection ram can precompress the resin in the cylinder. The molten polymer rapidly fills the cavity when the valves are opened. Such a technique enables the molder to fill a thin-wall or deep-draw mold quickly with little drop in pressure and without the characteristic "packing" phenomenon at the gate area. Parts molded by this method show fewer strains and, therefore, warpage and shrinkage can be controlled and held to a minimum.

Conclusion

Space does not permit a more detailed discussion of each type of multi-gating shown. This article serves only as a guide to assist the molder or moldmaker in the proper selection and design of the system which best fits his needs.

Summing up, these are just a few of the new methods that can be used by molders and moldmakers to insure production of better molded high-density polyethylene products at the lowest possible cost.

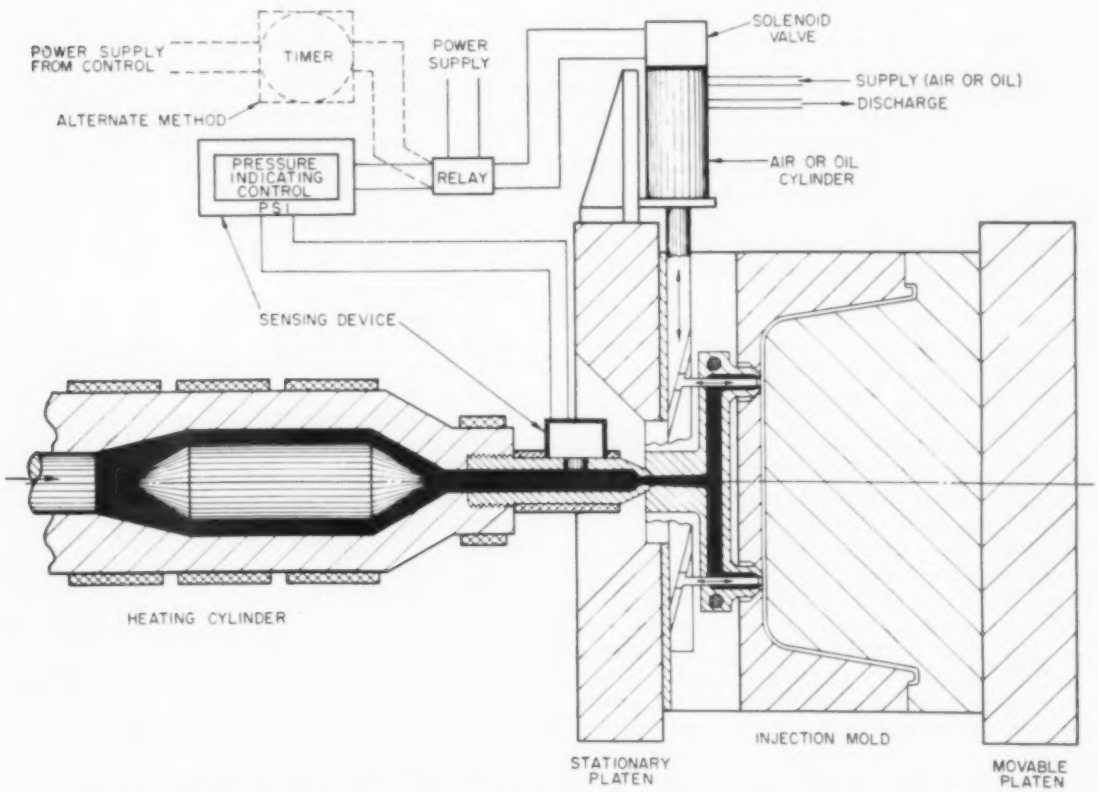

Fig. 5. Cross-sectional view of hot-runner, multiple-valve gate molding arrangement (Patent Nos. 2,770,011 and 2,773,284 owned by Columbus Plastic Products, Inc., Columbus, O.)

—THE END

Effects of secondary plasticizers on processing of vinyls—I

The first section of a two-part article showing how a vinyl processor can achieve required properties in specific applications

P. D. SHARPE

Plasticizers have been defined as liquids or solids which are incorporated into natural and synthetic resins and related materials to develop specific properties such as flexibility and toughness. A broad division of plasticizers has been made into primary and secondary types. A primary plasticizer can be used alone to give the desired properties, whereas a secondary type must be used in conjunction with a primary one.

The work described in this paper emphasizes the latter class, or secondary materials. Secondary plasticizers, too, are generally divided into two types: (1). Extender plasticizers which are high-boiling, relatively non-solvent products used with primary materials to modify resin properties and to lower costs; and (2). Specialty plasticizers or materials incorporated with resins to impart specific characteristics.

Neither of these secondary types generally is adequate to be used as the sole plasticizer. The type and amount of secondary plasticizer used in any formulation is determined by the desired ultimate properties of the compound, such as physical properties, volatility, low-temperature flexibility, or a host of others.

What differentiates a primary plasticizer from a secondary? Primary materials are completely compatible with the resin in all proportions and, as such, may be said to act as true solvents. On the other hand, secondary plasticizers are those whose compatibility is limited. The distinction, in other words, is based on the solvency of the plasticizer with the resin. For practical purposes, a plasticizer which does not exude from a plasticized composition on long standing is considered to be primary. Borderline primary plasticizers may exude if present in high concentrations. Excessive exudation, in general, may be attributed to the presence of secondary plasticizers used in excess of their compatibility.

The acceptance of secondary plasticizers by the vinyl industry has been slow and gradual. The growth of the vinyl industry was phenomenal, and the growth of plasticizers for vinyls naturally followed. In the early stages, the trend was to use secondary plasticizers beyond their range of usefulness. This, of course, resulted in this type of product becoming discredited. Now, however, through realistic claims made by the suppliers of secondary plasticizers, and through the experiences of the vinyl formulators and compounders, the vinyl industry has learned how to derive benefits such as lower cost and improved processing characteristics. Quality products CAN be obtained through the use of secondary plasticizers.

In this paper, we are attempting to show, realistically, the fields of applications for secondary vinyl plasticizers. We will point out the benefits derived from their use in various types of compounds, as well as show where their deficiencies exist.

The products classified as secondary plasticizers are many and varied. A great many of the so-called ex-

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tender types are alkyl-aryl hydrocarbons and high-boiling aromatic hydrocarbon types derived from the petroleum industry. Other secondary plasticizers include chlorinated, hydrogenated, and nitrated alkyl-aryl hydrocarbons. Mono-esters of fatty acids also are used as secondaries.

Aromatic and aliphatic chlorinated-type plasticizers are used in limited amounts to improve flame resistance. The polymeric-type epoxy plasticizers all improve light and heat stability of a vinyl compound, and are used in low concentrations (3-5 parts per hundred of resin). Monomeric epoxy plasticizers are less effective as heat stabilizers, but provide improved low-temperature flexibility. The extender-type hydrocarbon plasticizers provide significant improvements in the economics of a vinyl compound. Products in this latter group not only impart useful characteristics to vinyl resins, but are made up, for the most part, of low-cost materials. Generally, but with conspicuous exceptions, these extender-type hydrocarbons are low-priced liquids.

Since the industry has become so competitive and price conscious, the extender hydrocarbons—their advantages and disadvantages, and their potentialities for saving money—are of great interest.

Test Results

Several typical hydrocarbon-type extenders used commercially as secondary plasticizers are shown in Table 1. A chlorinated paraffin also is included since it is widely used by the industry for a specific purpose. The list shown is by no means inclusive, but is representative of the more commonly used low-cost, secondary plasticizers. For the sake of brevity, these plasticizers have been identified by code letter and are so discussed throughout this paper.

A standard formulation shown below was used to determine the properties which were obtained by using secondary hydrocarbon plasticizers as replacements for incremental amounts of an ester phthalate plasticizer.

	Parts
Polyvinyl Chloride Resin	100
Plasticizer	50
Epoxy Stabilizer	3
Stabilizer	2

Dioctyl phthalate was used as the control plasticizer. Replacements of the control were made with 15%, 20%, and 25% of the secondary plasticizers under test. The more aromatic secondary hydrocarbons, Plasticizers H and I, were investigated at their maximum compatibility limits. This was at 70% replacement for Plasticizer H, and at 100% replacement for Plasticizer I.

Comparative performance properties were obtained on tensile properties; extraction in water, oil, and gasoline; volatility; heat and light stability; lacquer lifting; and low-temperature flexibility.

Fusion

Two factors are involved in effecting fusion; the solvent action of the plasticizer on the resin, and the rate of heat input into the mass. Fusion of the resin and the plasticizer system is accomplished at elevated temperatures. The ability to fuse at lower temperatures and still obtain maximum tensile properties is associated with the ability of the plasticizer to solvate the resin. Aromatic plasticizers exert a strong fusion action on the resin and lower the fusion time. Stated differently, the mass can be fused at lower temperatures, in proportion to the aromatic content of the plasticizer system.

Batch-mixing time was kept constant at five minutes and the roll temperature was maintained at approximately 320° F., in order to keep variables at a minimum in this study. However, it was noted that the plastic sheet would form more quickly on the rolls when aromatic secondary plasticizers were part of the plasticizer system. The more aromatic the secondary plasticizer and the greater the volume used, the more quickly the sheet formed. For example, the compound using all DOP required almost two minutes for the sheet to form on the rolls. The compound using the very highly aromatic plasticizer, Plasticizer I, required less than one minute for sheet formation. The compound using a 25% replacement of the ester with Plasticizer A, the special petroleum fraction, required slightly more than two minutes.

Previous work has shown that very highly aromatic hydrocarbon plasticizers can be used as the sole plasticizer in a vinyl system with accepted limitations of

Table I. Typical Secondary Hydrocarbon Plasticizers for Vinyl Resins.

Chemical Type	Letter Code	Specific Gravity	Viscosity, CPS. 100° F.	Viscosity, CPS. 210° F.	Approx. Molecular Weight
Special Petroleum Fraction	A	0.8899	8.89	2.33	267
Aromatic Hydrocarbon	B	0.9786	—	20.7	5-8
Aromatic Hydrocarbon	C	1.014	143	6.8	270 avg.
Alkyl-aryl Hydrocarbon	D	0.878	17.9	3.33	280
Partially Hydrogenated Alkyl-aryl Hydrocarbon	E	0.970	9.38	—	200
Partially Hydrogenated Terphenyl	F	1.001	70*	—	237
Alkylated Naphthalene	G	0.944	49.7	4.20	240
Aromatic Hydrocarbon Extender	H	1.02	92.6	5.74	275
Very Aromatic Hydrocarbon**	I	1.09	11.85	2.31	235
Chlorinated Paraffin	J	1.15	17.4-21.6*	—	570

* At 77° F.
** Experimental at present.

color and volatility. Such aromtic plasticizers will effect reductions of 15-20° F. in fusion temperatures while still imparting maximum tensile properties to a vinyl plastic. Their combination with certain polyvinyl chloride resins materially assist in further reductions of about 15° F. in fusion temperatures. The less aromatic hydrocarbon plasticizers such as Plasticizer A will not be of advantage for lower fusion temperatures, and often may require about a 5° F. higher temperature when used in blends with primary esters.

The major consideration of a compounder in selecting a plasticizer is to obtain the best combination of properties in the ultimate vinyl product at a competitive price. The properties required may be many, depending on the end-use of the product. Compatibility, chemical stability, and low volatility are musts, since these are concerned with product permanence. Other properties such as low-temperature flexibility, stability to heat and light, migration, odor, color, electrical properties, flammability, and physical properties must be considered. The intended end-use of the plastic determines the relative importance of each of these properties.

Compatibility

Compatibility is the primary requirement of a plasticizer. The product must remain in the plastic, and exhibit no "oiliness" or surface tackiness under various conditions throughout its service life. If a product considered for secondary use can replace large amounts of the primary plasticizer without detracting too greatly from ultimate properties, it is of interest to the vinyl compounder. Secondary hydrocarbon plasticizers currently marketed are suggested as replacements for primary products at anywhere from 15-100%, provided the limitations are acceptable.

In investigating the compatibility limits of the various secondary plasticizers, a number of tests were used, as follows:

(1). The ability to produce a satisfactory sheet on the mill with no evidence of "sweating" on cooling.

(2). Films of the plastic were tightly rolled, placed in a cellophane bag, and the bag and its contents placed in an oven at 120° F. for 24 hours. After this exposure, the films were unrolled and examined in the inner-fold creases for signs of plasticizer exudation.

(3). Films of the plastic were sandwiched between cellophane and a one-pound load was placed on top. Samples were examined after one week at room temperature for signs of exudation.

(4). Films were exposed to ultraviolet light in a Fadeometer at an ambient temperature at 140° F. The films were examined after 24 hours for signs of sweating or tackiness as evidence of incompatibility.

Special petroleum fractions of the non-solvent type hydrocarbon are regarded essentially as diluents. Their chief function is to separate the polymer molecules and decrease the attractive forces between them. In so doing, the diluent-type plasticizer provides points of bending or flexing, since they impose less resistance to distortion than does the high molecular-weight resin. Consequently, a certain amount of flexibility can be obtained with a non-solvent type of plasticizer.

The special petroleum fraction (Plasticizer A) can be used as 25% maximum replacement for an ester such as DOP. Aromatic hydrocarbons, such as Plasticizers B and C, likewise are suitable as 25% replacements for esters. These latter materials can vary in aromatic content which will, in turn, influence their degree of compatibility. However, 25% always is a safe figure. The alkyl-aryl hydrocarbon type (Plasticizer D) and alkylated naphthalene type (Plasticizer G) should not be used for more than 25% replacements of esters, or they will prove incompatible. The terphenyls (Plasticizer F) are higher in aromatics and are compatible to the extent of 30-35% replacement of an ester. The aromatic hydrocarbon extender, (Plasticizer H) shown in Table 1 and used in this study, was quite aromatic. It could be used as a 70% replacement for an ester without exuding. The very aromatic hydrocarbon investigated, Plasticizer I, was essentially 100% aromatic for all practical purposes. Extensive tests with this material have shown that it can be used alone in a vinyl plasticizer system with no evidence of incompatibility.

Unusual conditions will create problems with secondary plasticizers as they do with primary materials. For example, exudation often is attributed to lack of plasticizer compatibility, when it may be that a small amount of additive is the responsible factor. Small amounts of lubricants such as stearates, waxes, or mineral oil are sufficient to offset the balance of compatibility between a secondary plasticizer and a resin.

Many secondary plasticizers, especially the special petroleum fractions, have "built-in" lubricity and additional lubricants are not necessary. Likewise, the partially-aromatic hydrocarbons may have small amounts of wax present which can eliminate the necessity for lubricants. When lubricants are necessary, as in highly-filled compounds, more solvating-type plasticizers should be used.

Not all plasticizers are mutually compatible. Fatty acid esters, chlorinated materials, and certain polymeric plasticizers are critical in systems already containing secondary plasticizers. These should be thoroughly investigated, since they may tend to upset the balance.

Compounds containing fillers of high oil-absorptive properties, such as certain carbonates and barytes, can hold more plasticizer and tolerate higher amounts of secondary products. For example, a secondary plasticizer recommended as a 25% replacement in an unfilled compound can be used as a 30% replacement in a filled compound containing 25 or more parts per hundred of resin. The maximum replacement of an ester plasticizer should be made with a secondary product to get the fullest advantage of cost savings on a volume basis.

Resistance to Extraction

Plasticized vinyl compounds are subjected to extraction by various media. Secondary plasticizers affect resistance to extraction of plastic compositions as compared with an all-ester compound.

In this study, 10-mil films containing the secondary plasticizers under test were subjected to three different

Table 2. Extraction of Secondary Plasticizers by Various Media (50 phr Total Plasticizer).

DOP Primary Plasticizer, %	Secondary Plasticizer %	Secondary Plasticizer Code	Percent Weight Loss in 1% Soap Solution	Percent Weight Loss in Unleaded Gasoline	Percent Weight Loss in White Oil
100	—	—	1.9	14.5	14.2
85	15	A	2.1	18.8	13.1
80	20	A	2.5	18.1	12.8
75	25	A	2.3	17.3	11.8
85	15	B	1.4	17.5	12.9
80	20	B	1.7	16.6	11.9
75	25	B	1.5	15.5	9.9
85	15	C	2.6	12.3	12.2
80	20	C	1.6	11.6	13.7
75	25	C	1.9	10.1	11.8
85	15	D	2.1	19.9	14.8
80	20	D	2.4	20.9	13.8
75	25	D	3.7	19.2	13.4
85	15	E	2.1	15.0	14.1
80	20	E	3.3	15.1	13.9
75	25	E	3.1	13.0	12.4
85	15	F	2.3	14.1	14.2
80	20	F	2.6	13.9	13.3
75	25	F	2.7	12.5	14.0
85	15	G	1.6	15.2	13.2
80	20	G	1.6	16.6	11.8
75	25	G	2.1	16.1	11.8
75	25	H	3.3	11.5	11.9
50	50	H	2.5	8.1	7.3
30	70	H	1.7	8.0	6.4
75	25	I	2.2	9.8	16.9
50	50	I	2.6	1.3	13.3
25	75	I	2.8	0.4	11.8
0	100	I	3.2	0.1	9.5
85	15	J	2.0	13.6	12.7
80	20	J	1.2	14.3	11.8
75	25	J	1.1	11.8	11.6

media for different periods of time; a 1% soap solution for seven days, unleaded gasoline for two hours, and a white oil for 10 days. At the end of the test, the samples were completely dried, reconditioned, and weighed for percent change. The results are shown in Table 2.

SOAPY WATER EXTRACTION. Secondary plasticizers have very little effect on the resistance of a vinyl plastic to soapy water extraction. The aromatic products, alkylated napthalenes (Plasticizer G), and chlorinated paraffins (Plasticizer J) are better than or comparable to DOP in this property. The special petroleum fraction (Plasticizer A) shows a slightly higher loss as compared with DOP. The more aromatic plasticizers, Plasticizers H and I, when used at their maximum compatibility limits, show about a 1% higher loss than DOP.

UNLEADED GASOLINE. The highly aromatic hydrocarbons show excellent resistance to gasoline extraction, as compared with DOP. The use of the aromatics in blends with one ester reduces the high losses exhibited by the latter. One of the more aromatic hydrocarbons (Plasticizer C) also shows some improvement in resistance to gasoline extraction. The special petroleum fraction (A), alkyl-aryl hydrocarbons (D), and alkylated naphthalenes (G) have no effect on this property.

OIL EXTRACTION. The more aromatic hydrocarbons (Plasticizers H and I), if used in sufficient amounts, improve oil-extraction resistance of plasticizers in vinyl compounds. The aromatic products (Plasticizers B and C), are also effective for reducing oil extraction. The other plasticizers investigated also show lower extraction losses than 100% DOP when used as 25% replacements. The exception is the terphenyl (Plasticizer F), which is no better than the ester for oil extraction.

Volatility

Plastic compositions depend upon plasticizers for their flexibility. Retention, therefore, is very important; that is, the plasticizer should not volatilize too much in service. Practical ranges will vary, depending upon the percentage of plasticizer used, the thickness of the plastic material, and the service conditions. The tendency of a plasticizer to volatilize is a function of the plasticizer's vapor pressure and molecular weight. For example, the high-viscosity aromatic hydrocarbons (Plasticizers B and C) show less volatile loss than do the lower viscosity aromatic hydrocarbons.

Production processes for gel-coated glass-polyester plumbing fixtures

J. A. WILLS

A step-by-step discussion of gel coat formulations, molding processes, and design requirements.

The manufacture of reinforced plastics plumbing fixtures is an established, growing business. Nine years have passed since the first commercial units were installed and at the end of 1959 more than 250,000 bathroom fixtures—mostly shower-pans and stalls were successfully installed. The issuance of the first national sanction by the Federal Housing Administration for a reinforced-plastics bathroom fixture on Dec. 9, 1959 blew the lid off the quiet period. It is conservatively estimated that more than one million units will be sold in 1960-1961. The industry has equipped itself with two, hard-won Commercial Standards: CS 221-59 for bathtubs, and CS222-59 for shower receptors (1).* Basically, these products are produced as gel-coated, low-temperature cured, fibrous glass-reinforced polyester items made by "wet lay-up."

Three essentials are necessary to produce a product which will meet Industry Standards and, therefore plumbing officials and Federal Agencies: These economical but reliable tooling; procurement or formulation of the gel coat; and a suitable process which will allow use of the first two.

This, clearly, is not an industry where the process creates the product. The decision to enter this field must include a fore-knowledge that the end-use of metal and ceramic plumbing fixtures has been known to the consumer for decades. Reinforced-plastics surfaces produced by conventional matched dies which feature reinforcement textures, while structurally satisfactory, would be classed as novelties. No practical thermoplastic appears likely to pass many of the plumbing codes.

It is the reinforced-plastics plumbing fixture industry which, of necessity, developed the "gel coat" system to meet the conditional requirements of its products.

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In presenting details of the three essentials previously mentioned, the gel coat will be considered first since it not only is the key to usable products, but is also necessary to the production of satisfactory molds.

Polyester Gel Coats

There are many commercially-available gel coats which are satisfactory for many purposes. However, because they are formulated for many purposes and often require concessions to meet "average" shop conditions and equipment, they are not considered ideal for plumbing fixtures. Molds, whether for plumbing fixtures or other wet lay-up products, usually cannot be made using the same gel coat as for the product. Reference to Table 1 will indicate typical ingredient formulations for mold gel coat and product gel coats. While many variations are possible, those illustrated are time-proven reliables and, therefore, can be considered basic.

Examination of the four formulations will indicate the presence of relatively small amounts of flexible resin in all cases. This provides air-side tack to the cured gel coat which assures positive bond to subsequent laminations. Where cloth is to be applied as the initial reinforcing layer, this tack assists in tailoring the unimpregnated material. A very slight flexibility also is imparted to the gel coat. Cab-o-sil[2] is added for thixotropy. Additions of more than 8% titanium dioxide per 100 parts of resin should be avoided because of inhibition tendencies beyond this point. Calcium carbonate, which is used to increase hiding power, will not appreciably affect cure except when activated. Addition greater than 5%, however, will increase viscosity, cause yellowing, and increase run-off.

* Numbers in parentheses refer to Bibliography at end of article.
[2] Product of Godfrey L. Cabot, Inc., Boston, Mass.

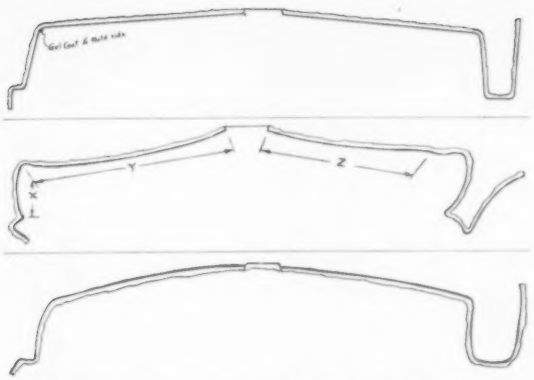

Fig. 1. Sectional drawings of shower receptor shell (inverted); (Upper) true shape along centerline; (Center) exaggerated expected result of warpage caused by unbalanced shrinkage if part were made over mold of true shape shown above, warpage of areas x, y, z could be tolerated; and (Lower) exaggerated view of prewarped mold required to produce true shape shown in upper drawing.

mixing, followed by pressure straining through a 100-mesh screen.

Gel coats are milled very satisfactorily with ball grinders. Conventional ceramic or stainless-steel barrels and balls are used for whites, and iron or steel may be used for darks and blacks. Average ball grinding time for a 50-gallon mix is eight hours. Collins, Charlotte, Baker-Perkins, or other equipment also may be used.

Mixing Procedures

MOLD GEL COAT (FORMULA A IN TABLE 1). Basic resins and promotor or accelerator are charged into the running propeller blender. Separately, lampblack and styrene are made into smooth paste with a spatula, and washed into the blender using basic resin as wash. Cab-o-sil is then added. Average propeller mixing time, where grinding is not to be performed, is four hours. Less time need be allowed for mixing if the batch temperature exceeds 105° F. Then, the mix should be pressure-strained through a 100-mesh screen. Where grinding operations are to follow, pre-mix only need be blended until Cab-o-sil is folded in.

PRODUCTION GEL COATS (FORMULAS B, C, AND D IN TABLE 1). Basic resins and promotor or accelerator are charged into the running propeller blender. All other ingredients are fed slowly to the propeller cone. Mix for 45 minutes, or less if the batch temperature exceeds 105° F. Charge to grinder.

Storage

These gel coats with the exception of those containing Surfex MM##, which has a special surface treatment, may be stored safely within the recommended storage life of the original resin. Settling would not normally be expected, but mild propeller mixing after slowly warming to 75-85° is recommended.

Preparation & Application

All four formulations in Table 1 are designed for use in conventional pressure-pot spray equipment, such as a Binks Model 18 with cap #68PB, nozzle #68T901, and needle #68T1074. Approximate line pressures are 75 and 50 psig. (pot). Viscosity of the gel coat more than 24 hours after mixing will be approximately 80 at 75° F., and 35-45 at 100° F. (Zahn cup #5).

It is important that all desired spray viscosities be adjusted to a predetermined temperature, usually around 85°. No solvent except styrene should be used, and this only to adjust absolute maximum spraying viscosity at specified temperatures, depending upon equipment used. The use of solvents, especially acetone, should be avoided due to likelihood of entrapment; with resultant shrinkage, blushing, pin-holes, and the possibility of causing azeotropes. If it is necessary to adjust the viscosity upward, more Cab-o-sil is added to the original mix. Pourable gel coats, such as those used in marbleized effects, will be discussed subsequently. They are formulated in the same manner as are sprayable types, but contain additional Cab-o-sil to meet desired pour viscosities.

Catalysis of these formulations follows the general wet lay-up practice using a catalyst—promoter system.

Since actual application of sprayed gel coats is rapid, catalysis is adjusted to give a practical gel time within batch limits. If two-pot systems are used, practical gel time is adjusted to match mold, air, and gel coat temperatures. Either methyl-ethyl-ketone peroxide with cobalt, or benzoyl peroxide and dimethyl aniline curing agents are used. Both systems may be used for single-pot operations, with M.E.K. peroxide and cobalt being the preferred system. The benzoyl peroxide and dimethyl aniline system is used only in two-pot methods. Table 2 will serve as a guide to catalyst-promoter combinations.

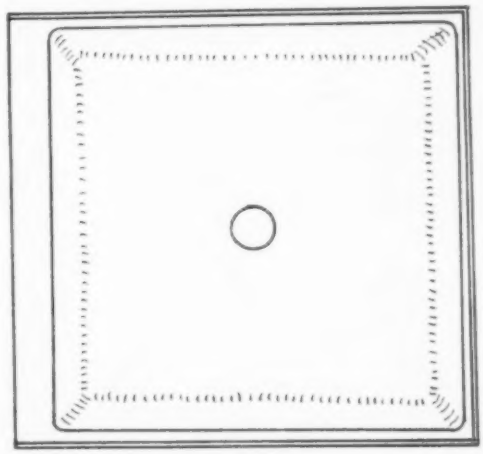

Fig. 2. Drawing showing true shape of shower receptor (top view).

Mold Construction

The production of duplicate molds on an economical basis will produce the best possible piece at the lowest cost. An original full-size model is built which not only represents the exact physical detail of the product,

Product of Diamond Alkali Co., Cleveland, O.

Table 1. Typical Formulations for Gel Coats.*

Formula A — Gel Coat for Molds.	Amount, pph.
Laminac# 4116 orthophthalic rigid polyester	84.75
Laminac 4134 orthophthalic flexible polyester	6.50
Germantown "Bear" Lampblack**	2.00
Styrene	4.75
Cab-o-sil## colloidal silica	2.00
	100.00
Add cobalt naphthanate, 6%, at 0.75% of resin weight	0.68
	100.68
Catalyst: Methyl-ethyl ketone peroxide, 1-2%	

Formula B — Orthophthalic Production Gel Coat.	
Basic Resin Mix:	
Laminac 4103	90.0
Laminac 4134	5.0
Styrene	5.0
	100.0
White Gel Coat:	
Basic Resin Mix	88.0
Surfex*** M-M surface-treated calcium carbonate	5.0
Titanox### RA titanium dioxide	5.0
Cab-o-sil	2.0
	100.0

Formula C — Isophthalic Production Gel Coat.	
Basic Resin Mix:	
Polylite**** SF3631 isophthalic rigid polyester	60.0
Polylite 8130 isophthalic flexible polyester	30.0
Polylite 8120 orthophthalic flexible polyester	10.0
	100.0
Add promoters as required, see Table 2.	
White Gel Coat:	
Basic Resin Mix	88.0
Snowflake#### untreated calcium carbonate	5.0
Titanox RA	5.0
Cab-o-sil	2.0
	100.0

Formula D — Methyl Methacrylate-Polyester	
Production Gel Coat.	
Basic Resin Mix:	
Paraplex***** P444A	80.0
Paraplex P-13 orthophthalic flexible polyester	5.0
Styrene	15.0
	100.0
Add promoters as required, see Table 2.	
White Gel Coat:	
Basic Resin Mix	88.0
Snowflake	5.0
Titanox RA	5.0
Cab-o-sil	2.0
	100.0

* Formulations computed to give a sprayable viscosity using standard pressure-pot equipment. Viscosities can be adjusted with styrene; no other solvent should be used. Cab-o-sil can be added to increase viscosities. Formulations are designed to be sufficiently thixotropic to hang on vertical waxed plate glass when sprayed.

Trade mark of American Cyanamid Co., New York, N. Y.

** Trade mark of Monsanto Chemical Co., St. Louis, Mo.

Trade mark of Godfrey L. Cabot, Inc., Boston, Mass.

*** Trade mark of Diamond Alkali Co., Cleveland, O.

Trade mark of Titanium Pigment Corp., New York, N. Y.

**** Trade mark of Reichhold Chemicals, Inc., White Plains, N. Y.

Trade mark of Thompson, Weinman & Co., New York, N. Y.

***** Trade mark of Rohm & Haas Co., Philadelphia, Pa.

but also allows for the natural shrinkage of the resin laminate together with its predicted warpage.

Production tools are constructed from polyester resin-fibrous glass materials. Epoxy-faced or all-epoxy laminates are also used to a limited degree. Like production parts, original tools are made from a single pattern by open wet lay-up methods. Also like production parts, they must be considered as unbalanced laminates subject to predictable warpage caused by unbalanced shrinkage (2).

The usual sequence of events in producing duplicate tools is the creation of any original full-size model possessing "prewarped" shapes and allowances for two or three shrinkages before commencing construction. To produce a quantity of duplicate tools, a master mold is made which, except for shrinkage allowance and pre-warpage, duplicates the original model. This, of course, will possess the additional features required of each mold such as supporting flanges and stiffening shapes outside the trim area. Except for more material and required labor, a mold made with a well-constructed master will cost little more than a few times that of a part.

Linear shrinkage for most laminates of this type can be assumed to be about 0.004-inch/inch. This figure, in itself, is negligible for dimensional allowances with plumbing fixtures, however, the effect of this relatively slight shrinkage can produce bow warpage in a panel made from a flat mold as much as $\frac{3}{16}$-inch per linear foot of free panel. Shrinkage always is concave to the gel coat- or mold-side. To produce a flat panel without turned edges, a foot square panel will require a mold having $\frac{1}{8}$-$\frac{3}{16}$-inch of spherical crown. From a practical standpoint, this situation changes somewhat when predicting warpage on five-sided box shapes such as shower receptor molds and parts (see Figure 1).

It must be remembered that a five-sided open box will also have eight major corners which would be considered non-yielding. Shrinkage stresses set up by corners produce warpage (see Figures 2, 3, & 4).

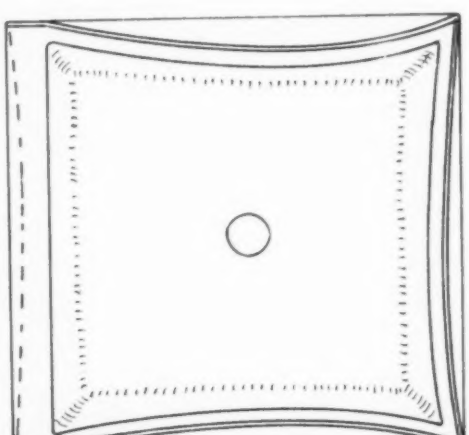

Fig. 3. Drawing of exaggerated expected result of top or unrestricted edges of shower receptor if part were made from mold of true shape (see Figure 2).

Materials

The mold gel-coat is used as the initial application over the full-size model. This is applied in the same manner as the production gel-coat which will be described subsequently. The resin used for molds is a high heat-distortion type with good impact strength (such as Laminacs 4111, 4123, or 4128). These are applied by standard hand, wet lay-up techniques.

The reinforcement used is generally of woven glass-fiber materials to provide increased stiffness and reduced shrinkage. Lamination of the mold is made progressively; e.g., after the gel coat is applied and cured, a single cloth of fine glass fiber is applied, impregnated, and cured. Progressively heavier fabric (including the woven rovings) is applied, three to four layers at a time, and cured. Progressive laminations and cures reduce shrinkage stresses and consequent warpage. All tools should be given a post-cure of 175-200° F. for a minimum of two hours.

Preparing Mold Surfaces

Whether or not production units require high luster, it is imperative that mold surfaces be finished to a fine degree. A variation of an older method has been described in the literature, but high-production plumbing fixture manufacturers generally will require the use of a film-forming type of mold release for purposes other than as a parting agent.

Lampblack-based gel coats produce brilliant surfaces. Retention and maintenance of high-gloss surfaces is an important key to mold longevity. Progressive dullness due to build-up of wax parting agents and erosion by solvents or free styrene will indicate the need for rebuffing. A new mold made with gel coat from formulation A in Table 1, thoroughly cured and highly polished, should not require rebuffing in less than 50 moldings. Equally important in preserving mold life and extending maintenance periods is the proper use of the mold in production. Parting agent wax should be applied as infrequently as possible and, when applied, should be machine buffed. Production gel coats should contain no organic solvents, and should be applied at as high a temperature as possible to reduce the amount of free styrene required for spray operations. Parts should be completely cured with an oven, if possible, and part and mold should be below 850° F. when removing the molding.

Molding Processes

Common to all processes are the preparation of the mold and application of the gel coat. Molds are first waxed and buffed, using a wax that is compatible with the water-soluble film-forming parting agent. If a parting agent is not used, a paste wax containing a high percentage of Carnauba should be employed. Molds are brought to a pre-determined temperature and the gel coat, if sprayed, is applied as previously described.

Four basic color or texture effects are used; monotone colors, light speckle, multi-colored terazzo, and marble. Speckle is achieved by adjusting a single-pot spray gun to a spatter pattern and droplets are applied lightly, followed by a conventional spray coat of monotone gel in a different color. Metallic specks or similar materials are blown onto a clear, water-white gel coat, followed by an opaque, back-up gel coat. Terazzo effects are applied in a similar fashion to speckle, except the initial spatter is larger and more widely spaced. After cure of the first spatter droplets, a second spatter color is applied as before, cured, and then the whole is sprayed by a third monotone (different, continuous color) coat and cured.

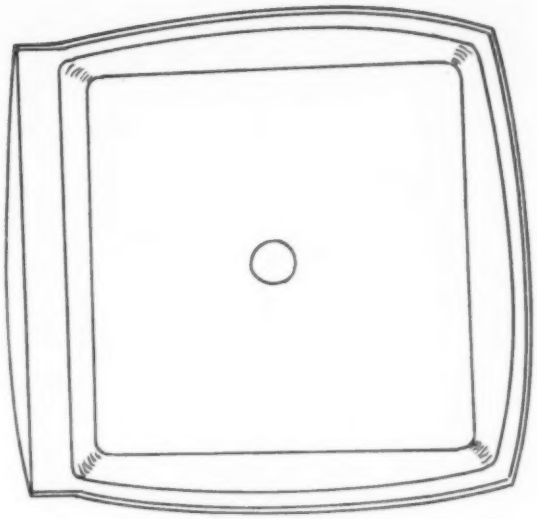

Fig. 4. Drawing of exaggerated prewarped mold shape required to reproduce true shape shown in Figure 2.

Marble gel coats are poured onto the mold in a single pour. Several colors may be incorporated, the viscosity of each adjusted by the addition of Cab-o-sil, but over-all viscosities are several times greater than the sprayable grades. Different viscosities of colors are used to either emphasize or run colors together. Each

Table 2. Approximate Gellation Times for Gel Coat Formulations Shown in Table 1.*

Two-Pot Application*

Benzoyl Peroxide, %		Dimethyl Aniline, %		Gel Time,
Pot	Final Blend	Pot	Final Blend	Minutes
2.0	1.0	0.25	0.125	15
2.0	1.0	0.20	0.100	16
2.0	1.0	0.15	0.075	20
1.5	0.75	0.25	0.125	18
1.5	0.75	0.20	0.100	16
1.0	0.50	0.25	0.125	21

Single-Pot Application#

Methyl-ethyl Ketone Peroxide, %	6% Cobalt Naphthenate, %	Gel Time, Minutes
0.5	0.25	25
0.5	0.50	20
0.5	0.75	18
1.0	0.25	17
1.0	0.50	15
1.0	0.75	11

* Figures using DeVilbiss MBC gun, needle MBC 496, nozzle MBC AV 601D, cap #24. Temperature of gel coat, mold, and room, 85° F.

Figures using a single-head gun of the same type used for two-pot applications.

color to be used is prepared in a separate container, then each is poured into a common container which finally is poured onto the mold. Over-all viscosity, color ratios, color viscosity, addition sequence of colors to the common container, and the pour pattern determine the effect of the resultant marble surface (see Figure 5).

Gel coat colors, except basic white, are made for all methods of application by the addition of three-roll mill color concentrates. These are inorganic pigments ground in a resin vehicle, usually diallyl phthalate.

Hand Lay-Up Process

The most widely used method for gel-coated plumbing fixtures is hand impregnation or hand lay-up method. Its principal advantage lies in the ability to use woven fabrics in conjunction with non-woven reinforcements. On an over-all strength basis, there is no disadvantage in labor or materials costs over any other system used for gel-coated products. Other advantages of the hand lay-up method include cleaner and smoother exterior surfaces, and no mechanical equipment required for impregnation.

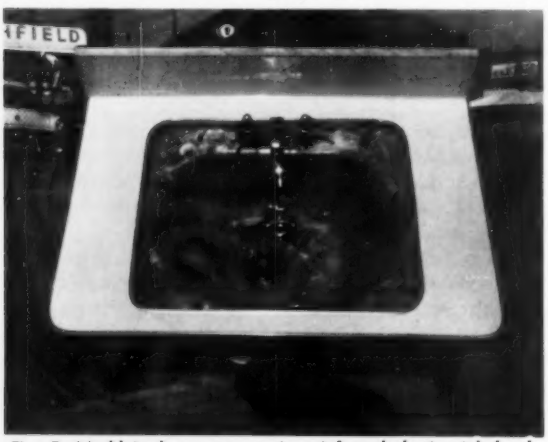

Fig. 5. Marbleized appearance in reinforced-plastic sink bowl.

The usual procedure is to apply one layer of approximately six-ounce glass fabric directly over the cured gel-coated surface. This layer is impregnated and cured, and is followed by one or more layers of glass fiber mat either as a tailored blanket or as a preform. An outer layer of woven glass fabric is placed over the mat, and the two are impregnated simultaneously using a rubber hand squeegee. The initial mold-size layer of glass cloth often is eliminated if strength requirements permit and if molders are sufficiently skilled in eliminating voids under the gel-coat surface due to air entrapment in the mat layer.

This method is used almost universally in the boat industry where maximum weight: strength ratios are required. Plumbing fixtures usually are not so heavily stressed as boats, and considerable advantage can be taken of under-supporting structures so that over-all laminate strengths per unit of stiffness are not so great. Average thickness for cloth-mat-cloth lay-up is 3/32-inch, yielding industry standard tensile strength requirements greater than 900 pounds per lineal inch.

Spray-Up Method

This process centers principally around the use of a special piece of equipment combining multi-head spray guns and a glass-roving distribution device. Patent claims are made by at least one company, but several types of units are available from others (3).

Since the most important single strength factor for glass-reinforced plumbing fixtures is stiffness, unwoven glass reinforcement used throughout is satisfactory. On a product thickness basis, approximately 25% additional material is used over the hand lay-up method to equal industry standard strength requirements. This also stems from the requirement that lower viscosity resins are used with corresponding lower physical values to allow for practical impregnation of fluffy unwoven reinforcements (see Figure 6).

The spray-up equipment usually operates by use of at least two spray heads, using the two-pot system previously described. A typical resin for gun operation would be Paraplex P-464. ### This and equivalent resins are low-viscosity types containing a thixotropic agent. One pot will contain resin with promoter, and the other will contain resin plus catalyst. Sprayheads may be driven by either air atomization or hydraulic pressure.

A relatively new approach to the spray-up method utilizes a means by which catalyst is introduced into the atomizing airstream by a carburation device. The Finn and Framm gun uses a one-pot source for resin which contains suitable promoters such as Selectron 5180**, an isophthalic with self-thixotropic qualities without the addition of colloidal silica. Resin is supplied to a single-head gun by a Pogo pump*** which is a positive-displacement unit. Resin catalized by the airstream meets chopped fiber from a cutter and is subsequently deposited. Principal advantage of this system is that no pre-catalized resin is required, one pot consisting of the original resin drum is the supply tank, and gel and cure rates are infinitely adjustable by regulating the flow of catalyst into the airstream.

Glass usually is deposited as a chopped fiber, but also may be applied as a continuous strand. Either way, deposition of glass is accomplished by impregnation with resin either simultaneously or subsequently. At intervals, it is necessary to use a hand roller to press glass fibers firmly to the old surface and remove entrapped air. This is a principal disadvantage to this method molding, since much which may have been gained by mechanized deposition of the materials is lost by the necessity for a hand-pressing operation.

Curing Cycle

Many processors depend on the "self-curing" qualities of promoted catalyzed resin systems to provide the sole means of cure. Good practice requires a post-cure of all products gelled at room temperature. Warpage, softness, and shrinkage often are experienced where the product is not cured completely. Many times, these problems are not experienced until un-

Product of Rohm & Haas Co., Philadelphia, Pa.
** Product of Pittsburgh Plate Glass Co., Pittsburgh, Pa.
*** Product of Binks Mfg. Co., Chicago, Ill.

crating or even after installation. Good process control will require a post-cure after complete gellation of the molding has taken place at room temperature. Air-circulating ovens heated at 175-190° F. are used for most post-curing operations.

Matched Molds

Matched molding of gel-coated plumbing fixture is limited to a patented process (4) under license arrangement which applies the principal of differentially-heated molds (see Figure 7).

Gel coats catalized to accommodate mold temperatures of 150-175° F. are sprayed onto a thin metal shell mold and gelled. Then a glass-mat preform is placed over the gel-coated mold; impregnated with resin; and the opposing mold half, which is heated continuously at 250° F., is lowered. A partial vacuum is applied just prior to final closing of both dies to withdraw air and lower the styrene vapor pressure. Upon final closing of the molds, the cooler mold is raised to 250° F. until the part is removed.

The resultant molding has the physical characteristics of an ordinary matched-die molding, except that a gel-coated surface is on the finished side.

There are some limitations to this process due to mold and equipment costs, added to inherent problems of many sizes and styles of fixtures required in one line. Production rates are not as favorable as with the other processes.

Back-Up Resins

Resins for the main molding, the area containing glass reinforcement, depend to some degree on the process used. Hand lay-up permits the use of resins possessing higher viscosities than does spray-up. Matched-mold operations allow use of even higher viscosities. Many advantages can be claimed correctly by every supplier, depending upon the situation. The usual practice is to select a resin with as high a viscosity as possible within the limits of the process used to reduce shrinkage and run-off, and yet provide greatest impact strength within practical structural limits. Most "general-purpose" polyester resins fall within the required range for reinforced areas of plumbing fixtures, provided moldings are given a saturated heat post-cure.

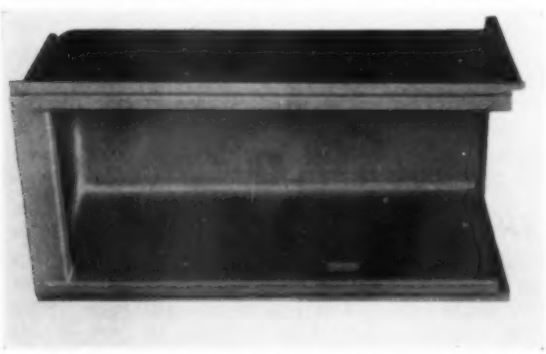

Fig. 6. Speckled, gel-coated, one-piece reinforced-plastic stall shower made by "spray-up" process has undersupport of polyurethane foam. (Credit: Rocky Mountain Fiberglass, Denver, Colo.)

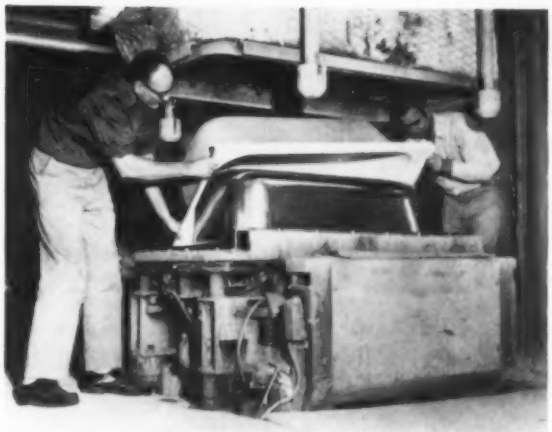

Fig. 7. Unique, patented process for production of reinforced-plastics bathtubs for mobile homes uses gel coat system and matched heated molds. (Credit: Sani-Glas, Inc., Amsterdam, N. Y.).

Plumbing Applications

Under-Structure

Plumbing fixtures which must bear heavy loads, such as bathtubs and shower receptors, are supported on the underside by various materials. Earlier units used materials such as foamed concrete, asphalt-impregnated organic fiberboard, and wood members. Urethane foams have been adopted almost universally by manufacturers who conform to industry standards (5). Foam of 2-4 pound density is poured into the cavity on the floor side of the shower receptors and stalls, while the floor side is supported by a foam poured into a ring mold approximately two inches thick.

Performance Records

During the nine-year period from development to respectable production, very few field failures have been reported, and rarely are due to ordinary use conditions. Industry standards provide 25-year service life requirements. Most reported failures have been due to improper installation and incorrect choice of under-supporting materials. Low shipping weight is a great economic advantage. A weight of 25 pounds is average for a 36 x 36-inch shower receptor as compared with 50-150 pounds for receptors made of other materials, thus allowing wide area distribution per plant. Consumer acceptance has been spectacular because of color styling and one-piece, leak-proof qualities.

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Matching injection molding equipment

How auxiliary equipment can be engineered to provide optimum performance and economy.

G. B. THAYER

Molding machines and attachments are available in a wide variety of styles, sizes, and functions — more than enough to fill a large catalog file with urgent messages and reasons why each item should be used throughout the injection molding plant. This equipment has been developed over the years to meet specific needs in hundreds of these plants, and each item has found favor and brought about good results in the plant where it has been developed. Sometimes, however, misunderstanding or mismatching of equipment has given poor results, and the picture is confusing at best, when the inventory of equipment is under consideration.

Injection molding plants which have a wide variety of molding work, and thus might be called general-purpose plants, must match the equipment carefully to provide optimum performance and economy. Specialized molding plants, and individual molding departments within a larger complex also need to do so in a different way for different reasons. It is important also to have the Production supervision and the Engineering Department understand the full meaning of proper equipment combination. It is very difficult to find the time to coordinate equipment inventory plans with all members of the organization. However, it is very likely to result in economy and attainment of the management objectives.

Plastics Specialist, Plastics Technical Service, The Dow Chemical Co., Midland, Mich.

Some examples of equipment combinations have been selected to illustrate what this means, and how to go about arranging equipment in specific types of plants for the ambient conditions encountered. Six major equipment groups have been arranged for the purpose of this discussion. These groups fall into a convenient pattern for describing the much larger number of individual items. Quantity-control for mold filling; anticipatory temperature control; mold temperature controllers; scrap grinders; hopper loaders, driers, and drying ovens; and specialized types of heating cylinders are the six groups which have been selected for discussion in this article.

Thorough organization of the equipment inventory is one of the first and most important steps needed for good housekeeping in the plant. In turn, good housekeeping assists greatly in the use of the specialized equipment, and the beneficial results become very important in the cost of operating the factory. For example, portability of equipment for greater versatility in the general-purpose molding plant, or permanent installations for specialized operations, are the first requisites of good housekeeping. If the equipment is portable, it is necessary to allow sufficient room around the machinery for placing this equipment and moving it to one side or another when cleaning the machines and the floor. Permanently-installed equipment may be placed where it does not interfere with the factory operation, and such items as conveyors should be placed where they do not create safety hazards for plant personnel.

A definite plan for matching injection molding equipment is important in the molding plant. Many people other than the maintenance engineer and the factory superintendent have ideas concerning the use, storage, and maintenance of this equipment. If there is no plan and no one in charge of planning, there is no way to utilize these ideas. Suggestions for improvement come from many directions, and most of the best ideas are likely to come from the people who are most intimately concerned with the use of the equipment. Greater efficiency can be attained by making it possible for these people to participate by contributing their ideas.

Matched equipment which is well placed and well used is relatively easy to keep in proper operating order. Manufacturers of injection molding machines provide instructions concerning change of hydraulic oil, maintenance of bearings and other parts, and general instructions for periodic maintenance. Usually, someone in the factory is appointed to observe these instructions, and to add others for the periodic maintenance of the auxiliary equipment. It is especially useful, for example, in providing proper electrical connections and keeping the electrical circuits of the machinery in proper operating condition. From the safety standpoint, electrical circuits of the machinery should be in proper operating condition. Electrical equipment must be inspected and repaired at regular intervals. Repair can be done much more satisfactorily when the equipment is out of operation and in the repair shop. Hurried repairs to start the machinery running again with a minimum of down-time are exactly that—hurried, and are not likely to be permanent or very good.

Mold Filling

Several means of quantity-control are available in the molding equipment list. Weigh feeders, nozzle valves, gate valves, pressure gages at the nozzle, pressure gages in the mold, and sequential-filling arrangements are the principal means of quantity control. The question of which to use or not to use is very much open in many molding plants. There are few, if any, standard attachments available for purchase other than weigh feeders. Other means of quantity control may be available from a single source, or must be built as a part of the mold itself.

If is necessary to understand fully what quantity control can do for the injection molding plant before one can decide which to use. There are a number of papers and written texts, along with bulletins and commercial literature which describe the various kinds of equipment and their advantages. In summary, any type of quantity control can reduce material consumption by as much as 15%, and is likely to be in proportion to the projected area of the molded parts. When too much plastic is fed into the mold, the mold opens up and allows the parts to be thicker. Quantity-control determines the thickness of the parts, and is most effective in material savings when the parts are large in area relative to their depth.

Quantity control is effective in reducing scrap loss from sticking on deep-draw parts. It can save as much as 100%, and there are many molds running today which could not produce parts at all without the quantity control exercised by weigh feeders. Reduction of scrap loss from sink marks is another factor which is affected appreciably by the quality of the quantity-control employed. It is not always possible to eliminate sink marks by any type of quantity control, but it is usually not feasible to try to reduce sink marks by faster injection without very good quantity control. Faster injection which allows the injection pressure to be distributed with greater uniformity throughout the mold is an important factor in reducing or eliminating sink marks. However, if the quantity of material is not controlled carefully, high pressure throughout the mold results, and can cause the mold to stick shut or the pieces to break or flash.

Quantity control has considerable effect on residual stress conditions and the resultant warping or decreased heat-distortion resistance. The weigh feeder is a universal means of quantity control, and is extremely effective for nearly all conditions of expected performance either in the custom-molding plant or in the specialized factory. Weigh feeders have been employed to provide uniform heating rates on preplasticizing machines, even though they do not provide direct control of the amount of plastic that is placed in the mold. Weigh feeders depend upon uniform cycle conditions to provide uniform weight of charge, as has been explained many times in the literature.

Valve-type quantity control can provide somewhat more precise control than weigh feeding if the valve is operated by a timer or by a pressure signal from the mold. Valve-control at each gate provides maximum precision per cavity. Valve-control on multiple-cavity molds requires careful gate and cavity flow resistance balancing to provide satisfactory parts from each cavity. Sequential filling can be employed to advantage in precision quantity control, and has a further advantage in allowing all of the material being forwarded by the injection plunger to go into a single cavity or a small group of cavities at the same time. Dividing the major flow of plastic to force it to go into the entire mold reduces the effectiveness of high plunger-speed, and increases the fill-time per cavity. Sequential filling decreases this fill-time by alowing all the flow of the machine to go into one cavity at a time.

These considerations must be fully understood before planning the equipment and matching it to do the work contemplated in the molding factory. There is no general rule, but some observations can be made tentatively. If the machine is to do many kinds of work, a weigh feeder is likely to be the best compromise. If the machine is to make long runs on the same mold or on molds for parts of similar nature, single- or multiple-nozzle valves may be more advantageous because of the faster filling offered. These factors must be evaluated for the specific need, and general considerations may be reversed or voided entirely under some conditions.

Anticipatory Temperature

Anticipatory temperature controls can provide extremely precise control of the surface temperature of the metal employed to heat the plastic material. This is what anticipatory temperature controllers do. If the molder arranges to take full advantage of precise control of heating surface temperatures, the extra cost of specialized anticipatory controllers is well worth the expense.

A conventional injection molding machine usually has power enough to push unmelted or poorly-melted granules through into the mold. This can be true also of preplasticizing machines if conventional heaters are used to feed the injection chamber. Several ways of matching the load and the equipment to allow efficient

utilization of anticipatory controls have been found successful. A uniform cycle is one of the first requirements to provide uniformly-heated material from one shot to the next. If the cycle is not exactly uniform, the anticipatory controllers will keep the metal surface temperature reasonably uniform, thus preventing overheating of the plastic. But, it is not likely to provide real uniformity throughout the plastic mass. For this reason, a uniform cycle is the first thing to be attained in order to match the load to the equipment.

Small orifices in the nozzle of a conventional heating cylinder or in the nozzle delivering material to the injection chamber of a preplasticizing machine have been found helpful in holding the material in the heater under considerably greater pressures. This prevents unmelted granules of the softer plastics from coming through into the molded part. Harder plastics also are assisted by this same means. The small orifice is also effective in mixing the plastic and, therefore, producing more uniform temperatures throughout the entire mass of the mold charge. Modern injection molding machines have sufficient hydraulic power to allow the use of relatively small nozzles—something not feasible until recently. Naturally, a free flow-type nozzle that does not cause kinetic pressure loss is required.

If anticipatory temperature controls are used on conventional heaters to feed the injection chamber of preplasticizing machines, it is advantageous to weigh-feed the material and time the strokes of the feed plunger so that all of the available cycle time can be used for stuffing the injection cylinder. Some machines can have the injection cylinder filled at only one stroke of the stuffing plunger, but others may use multiple strokes. If it is possible to use multiple strokes for feeding the injection chamber, it is advantageous to time them, and weigh the feed.

Mold Temperature

Several types of mold-temperature controllers are available, and all have their uses. Single-circuit heated water or oil heaters are useful under limited conditions. Single- and double-circuit heating or cooling are probably the most widely used mold-temperature regulators. Single-unit refrigerated water cooling units and plant-wide central water chilling systems have appeared here and there. The single use of plant water is a sixth means of mold-temperature regulation. Choice of type to be used depends on the conditions encountered in the specific plant for which mold-temperature regulation is being considered.

The mold-temperature requirements of the plastic are the first considerations, but not the only ones by any means. Most thermoplastics require the mold temperature to be higher than room temperature for satisfactory surface appearance and maximum inherent physical properties of the material. Few thermoplastics, as yet, require temperatures greater than that of boiling water, but current indications tend to higher temperatures.

All plastics must be cooled somewhat before removal from the mold. Heat removal must be accomplished without cooling the mold surface so much that it is not satisfactory for proper molding. Another requirement of mold-temperature control is to prevent local overheating of the mold surface or to provide local heating where it is needed.

No mold-temperature regulator can accomplish all of these things by itself. The heat-exchange fluid must circulate effectively in the mold before the regulator system can operate efficiently. This means that the mold design must be matched to the temperature-control system for economical performance. No one knows how much it costs to save tooling money by simplified mold-coring; the costs are buried in such manufacturing cost items as reject losses and rework charges.

The most versatile type of mold-temperature regulator is the double-circuit heating and cooling machine. This type of mold-temperature regulator is satisfactory for nearly all injection molding requirements. However, a single-circuit refrigerating unit sometimes is needed, and need not be extremely versatile because no matter where the refrigerated water is used, it usually is wanted as cold as it can be.

A central chilling system for refrigerated water is limited in its usefulness to plants producing some item in a major proportion of its machines—a specialized molding plant, rather than a general-purpose molding plant. Specialized conditions sometimes require central water treatment. In warm climates, where water supplies are limited, central chilling and chemical treatment are advisable. The water usually can be cooled economically by an evaporative cooler, and the cost for cooling of used water is likely to be less than the cost of new water.

When high injection speed produces fast mold filling, it often allows the use of lower than conventional mold temperature. So far, this has not included the use of chilled water, but there is a possibility that chilled water may be helpful in some cases. This is a relatively new factor in molding technology. When the mold is filled rapidly, low surface temperature has less effect on the material flow, and a somewhat greater effect in removing the heat more rapidly. This may be more of an "on paper" advantage than a practical one, but can be profitable in some cases.

Scrap Grinders

Many types of scrap grinders are available, and each of them has been developed for someone's idea of needs in the molding plant. The means for granulating the plastic have been selected by each manufacturer to produce granules of proper size with minimum fines and, at the same time, avoiding overheating the plastic. Ease of cleaning the grinder and sharpening its blades also are considerations which have been weighed carefully by each manufacturer. Considerations of hours of use versus maintenance costs can be seen readily by prospective purchasers, and the price of the grinder generally is a reflection of this consideration.

The problem of specifying a large grinder in a given spot or several smaller portable grinders which can be used at the machines continues to be an issue. Use of a large grinder in a fixed position places scrap grinding under control of someone who is assigned

the task. This removes it from control of the press operator who has a number of other things to do and often may not give full attention to the needs for grinding the scrap. However, this system has a tendency to allow the scrap to pick up dirt and dust and become contaminated before it can be ground and reprocessed for use.

The dust, which is inevitable when scrap is ground, is not likely to contaminate the material in hoppers of nearby molding machines, although it does present a problem in keeping the plant clean. When there is a change from one material to another, however, it is necessary to clean the grinder thoroughly to avoid contamination. This is also desirable when a change is made from one color to another within the same kind of material. Such clean-ups are relatively simple for portable grinders, but are more time-consuming for large grinders which are often used in a fixed position in the grinding room.

Sharpening the grinder is an important consideration. Grinder blades become dull from continued use in granulating the plastic. It is likely that the dulling is more a product of continued abrasion by the plastic than occasional abrasion by the passage of metal particles. When the grinder is dull, it tends to overheat the plastic and produce far too high a percentage of fines. If several grinders are used, it is advisable to try to have them be the same kind and size so that spare blades can be kept on hand ready to use while dull blades are removed for sharpening. This is not always possible because blades are sometimes balanced with the rotor in which they are assembled.

Electrical connections should be provided in a fixed and permanent location at the molding machine when portable scrap grinders are used. This avoids the use of long extension cords on the floor or draped through the factory to keep them off the floors.

The hot-runner mold has the advantage of reducing the amount of material which must be processed through the scrap grinder. Hot runners cannot always be used, and they do not eliminate short-shots or parts which are otherwise unsaleable and should be reground. In designing molds, it is well to consider how much material can be saved by designing runners and sprues for minimum size. For example, a round runner of ¼-inch diameter has only ⅔ the area of a runner of $\frac{3}{16}$-inch diameter. Considerable saving also can be made by employing short sprues of small diameter. In addition to material saving, small runners stiffen quickly and so do not lengthen the molding cycle. If the runner or sprue is too large, it often delays the molding cycle for its cooling. It is almost impossible to sell press time for molding runners and sprues because there always seems to be a competitor who does not engage in this practice.

Hopper Loaders, Driers, and Drying Ovens

Drying ovens, hopper driers, and hopper loaders form a group of materials preparation and handling equipment which has the following functions to perform: dry the materials; preheat them; and convey them to the machine hopper.

Certain materials require thorough drying, and this usually requires a drying oven. This type of drying nearly always leaves the granules thoroughly preheated, and it is advisable to maintain this preheat because it is an advantage in the molding process.

Ovens usually are not portable, and handling material from the fixed position of the oven to the fixed position of the machine in which it is to be used is likely to result in heat loss, and may also allow the material to pick up moisture on the way. Conveyors, such as are used for hopper loading, can be used to carry the plastic from the oven to the hopper, and the hopper drier can preserve the preheat. This hopper drier can be smaller and less costly than one which is expected to do a thorough job of drying and preheating.

Materials which do not absorb moisture do not need the elaborate features of a drying oven, since superficial moisture on the surface can be removed by a hopper drier of fairly large size. It is necessary to match the size of the hopper drier to the requirements of the molding machine, however. If the molding machine requires 200 pounds of material per hour, the hopper drier must be able to process this much material per hour. The hopper drier and hopper loader combination system sometimes is capable of conveying all of the material the machine requires, but is not capable of doing a thorough job of drying or preheating. This is usually not the fault of machine design, but can often be attributed to insufficient consideration of the entire nature of the requirements.

The proper combination of ovens and hopper driers with conveyors and loaders offers labor saving and product quality advantages, as well as cleanliness and materials saving, when it is considered thoroughly in the plant lay-out and processing procedure. This technological factor is relatively new and was not of major importance in the past when injection molding machines turned out relatively-few pounds per hour of material with non-critical requirements.

Specialized Heating Cylinders

Much can be said pro and con with regard to purchasing and using specialized heating cylinders. They sometimes result in up-grading the product quality, and sometimes they produce faster than the original-design equipment. Replacement of old heaters often is advisable if they have lost their efficiency when compared with newer types, even though they are in relatively good condition insofar as wear and soundness are concerned.

It is sometimes advisable to go beyond a consideration of heating cylinders alone. The use of a new injection end, including a revised hydraulic power plant, must be considered because part of the effectiveness of improvements comes from the hydraulic-power machinery. In fact, improvements in the hydraulic end often improve the performance of an existing heating cylinder.

It is necessary also to analyze the condition of the rest of the molding machine. Some new machines have provided decreased time for opening and closing by as much as 10 seconds or more in the total cycle.

This is a real advantage in labor saving, and sometimes it may be worthwhile to go all-out for every advantage in production ability, rather than obtain only part of the advantage by purchasing new heating cylinders.

The quality of the product produced and the pounds per hour through-put increase must be compared with the cost of the specialized cylinder. If there has been a change in a product mix or types of products molded on the machine since it originally was purchased, this has bearing on the decision to buy a specialized heater and on the kind of heating cylinder which will be specified.

Sometimes, it will be satisfactory merely to provide a new heating cylinder for improved efficiency. Other times, a new hydraulic system is needed, and this adds to the cost of the equipment. In some cases, it is not feasible to try to modernize a machine which already is too old, and a brand-new machine should be considered. All of these factors depend on an analysis of the earning power of the new equipment.

It is not possible to compute such figures for general cases, and it is not simple to make these computations in specific instances. A great deal of experience and judgment must be brought to bear on these problems where radical changes in heating cylinder equipment are involved. It is advisable to contain the engineering and analysis within the specific molding plant which is concerned, since there is a great deal of inside information required to make the decision. People who manufacture specialized equipment do not have access to this information, nor do they ordinarily have time within the structure of their price quotation to provide sufficient attention to the details which are involved. Their knowledge of the equipment which they make, plus their experience with its use in the field, are valuable factors which must be included in the analysis. Such information usually is provided cheerfully when requested, and the vendor enters the picture with considerably more confidence when his prospective purchaser is careful in analyzing his own problem. This results in much less risk on the part of the vendor and much more assurance of satisfactory performance.

Inventory Value Vs. Capital Value

The auxiliary equipment is used in the injection molding plant often is listed for inventory purposes under a "miscellaneous items" heading. This is convenient for accounting, but the equipment has far greater capital value as working tools than the lump sum of inventory dollar value indicates. When the equipment is used in proper arrangement, it has great earning power per dollar of investment.

There are so many kinds of auxiliary equipment available with overlapping or duplicate functions, that it becomes necessary to engineer the auxiliary into the production processing in order to obtain optimum performance and economy. It is necessary for several people who have responsibility for the various functions of the manufacturing organization to know the factors involved in using the equipment properly, and to participate in planning for this optimum use. —THE END

Announcing New Engineering Forum, "Consultants' Column"

Appearing in the June issue, and every other month in the future, will be a new Engineering Forum entitled "Consultants Column" and conducted by J. J. Scavuzzo and Dr. S. S. Stivala, Plastics Engineering Consultant and Polymer Consultant, respectively, for S & S Engineering Associates, Saddle Brook, N. J.

John (Jack) Scavuzzo was born in Passaic, N. J., in 1924. He attended Newark College of Engineering and Stevens Institute of Technology, receiving a B.S. in Mechanical Engineering in 1949. From 1949-1951, he was Asst. Plant Engineer at Tung-Sol Electric Co., Inc. Since 1951, he has been Chief, Plastics Applications Section, for Picatinny Arsenal. He also is a princpal in S & S Engineering Associates. Jack is a member of SPE. Mr. and Mrs. Scavuzzo and their daughter make their home in East Rutherford, N. J.

Salvatore Stivala was born in New York City in 1923. He attended Columbia University, receiving a B.S. in Chemistry and Chemical Engineering in 1948; Stevens Institute of Technology, receiving an M.S. in Chemical Engineering in 1952, and an M.S. in Chemistry in 1958; and the University of Pennsylvania where he was awarded a Ph.D. in Physical Chemistry in 1959. From 1949-1950, he was with U. S. Testing Co. as research Engineer in charge of the calibration laboratory. In 1950-1951, he was with Picatinny Arsenal in their Plastics Research Laboratory, doing physical research in plastics, rubbers, resins, propellants, etc., and was technical supervisor of plastic body armor development. From 1951-1957, he was with Stevens Institute of Technology, starting as Research Fellow in 1951-1952, and faculty member from 1952-1957. From 1957-1959, he was a National Science Foundation Science Faculty Fellow at the University of Pensylvania. He rejoined Stevens Institute in 1959 as Asst. Professor, and has been with them since that time. He is a member of Sigma Xi, Phi Lambda Upsilon, AIChE, ACS, SPE, and New York Academy of Science; has been awarded several patents; and has authored many publications. He also is a principal in S & S Engineering Associates. Dr. & Mrs. Stivala have two children, and reside in Coytesville, N. J.

PT's Comparative Data on 1960 Injection Molding Machines.

(Based on data submitted by the machine manufacturers.)

Manufacturer*	Crown	De Mattia			Fellows				HPM**	
Machine model	Twinmaster AT	G3	K2	M1	3-125	6-200	6-10-225	12-350	200-H-6/8A	200-P-28
Machine action	Auto.	Semi-auto.	Auto.	Auto.	Auto.	Auto.	Auto.	Semi-auto.	Auto. & Semi-automatic	
Machine type	Horiz.	Vert.	Horiz.	Horiz.	Horiz.	Horiz.	Horiz.	Horiz.	Horiz.	Horiz.
Clamping mechanism	Hydr.	Hydr.	Hydr.	Hydr.	Toggle	Toggle	Toggle	Toggle	Hydr.	Hydr.
Injection capacity, oz./shot	1-3/ram	4	4 - 6	12 - 16	3	6	6 - 10	12 - 20	6 - 8	28
Casting area, sq. in.**	Approx. 50	Approx. 45	Approx. 50	Approx. 135	30	70	—	115	--	--
Injection plunger stroke, in.	4	7½	7-3/4	11½	3½ - 5½	6 - 8½	10½	10½	10	10
Plunger speed, in./min.	1,200	187	362	690	114 min.	108 min.	108 min.	120 min.	138	268
Pressure on material, psi.	15,500-28,000#	20,500	20,250	22,500	20,000	20,000	19,380	20,000	20,000	20,000
Injection rate, lbs./hr.	Up to 100	70	100 max.	150 max.	6#	8.75#	8.75#	17.6#	675*	1,320*
Plasticizing capacity, lbs./hr.***	100	70	100	150	45	75	100	150	90	90
Cycles/hour	1,800 max. (actual)	360 dry	600 dry	720 dry	600-840	450-650	700-900	600-800	--	--
Mold: Size, in.	18 x 18	14 x 23	12 x 22V 14 x 20H	16 x 32V 20 x 30H	17 x 18½	12 x 24H 15 x 21V	15 x 25	33 x 33	15 x 26V 26 x 15H	15 x 26V 26 x 15H
Daylight opening, in.	16-3/4x16½	19 max.	20 max.	32 max.	5 - 8	6 - 9	8 - 14½	10 - 20	29	29
Thickness (min.-max.), in.	- - -	- - -	- - -	- - -	8 - 14	8 - 14	8 - 18	10 - 24	6 - 14	6 - 14
Locking force, tons	105	128	150	400	125	200	225	350	200	200
Clamping stroke (min.-max.) in.	6-10-3/4	9 - 15	12 max.	24 max.	8 max.	9 max.	14 max.	20 max.	0 - 15	0 - 15
Clamp tie bars or rods: Diameter, in.	3	3	2¾	5	2½	3	3½	4½	4	4
Space between (V x H), in.	10	14½x14½	14½x12½	18½x16½	10½x12-1/8	12½x15½	15½x15½	20½x20½	15½x15½	15½x15½
Hopper capacity, lbs.	80	50	50	100	50	75	150	90	80	80
Cylinder heating capacity, kilowatts	10	8.8	10	20.5	6 max.	12 max.	13 max.	21	13.6	23.6
Motor hp.	30	20	20	30	15	20	20	40	30	50
Oil tank or reservoir capacity, gals.	135	100	150	160	120	140	120	125	85	85
Special features	Twin injection rams to prevent packing of material into cavity. Preplasticizing. Positive shut-off.	Suitable for insert molding. Easy rapid mold installing.	Can also be used as semi-automatic. Extra-large platens. Auto. pre-pack.		Variable stroke adjustment. Speed-Flo heating cylinder.		Pre-Pac device.		- -	(See following page)
Optional features	Choice of 3/4" & 1½" plunger diameters.		Variable clamp. Can be equipped with hydr. valves for mold operation.		Prepack & preposition device. Gives up to 4½ oz. shots.	Gives up to 9 oz. shots.	30 hp. motor increases injection rate to 10.7 cu. in./sec. & cycles/hr. to 825-925.	Gives up to 20 oz. Prepack & preposition device.	(See following page) Weigh-feeder.	
					Nozzle temp. control; Air sweeps for part removal; Power take-off for aux. mold control; Press stroke controls; Dual injection pressure; Auto. door opener; Weigh-feeder.					
Approx. delivery time, weeks###	4 - 6	From stock	4 - 6	4 - 6	12 - 14	12 - 14	12 - 14	12 - 14	Immediate delivery on most models.	
	# On pre-plasticized materials.				# Cubic inches per second.				* Cubic inches/minute.	

* Complete manufacturers' names and addresses are as follows:

#Clifton Hydraulic Press Co., 287 Allwood Rd., Clifton, N. J.
Crown Machine & Tool Co., Inc., P. O. Box 246, Fort Worth, Tex.
De Mattia Machine & Tool Co., Chelsea Rd., Clifton, N. J. (Distributed by Brositex Machine Co., 50 Church St., New York 7, N. Y.)
Fellows Gear Shaper Co., Springfield, Vermont
#Guy P. Harvey & Son Corp., 40 Spruce St., Leominster, Mass.
The Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Improved Machinery, Inc., Nashua, N. H.
Lester Engineering Co., 2711 Church Ave., Cleveland 13, Ohio
Lombard Governor Corp., Ashland, Mass.
Moslo Machinery Co., 2443 Prospect Ave., Cleveland 15, Ohio
National Automatic Tool Co., Inc., Plastics Machinery Division, Richmond, Indiana
#Newbury Industries, Inc., Route 87, Newbury, Ohio
Reed-Prentice Division, Package Machinery Co., East Longmeadow, Mass.
#Simplomatic Mfg. Co., 4416 W. Chicago Ave., Chicago 51, Ill.
Standard Tool Co., 217 Hamilton St., Leominster, Mass.
F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.
Van Dorn Iron Works Co., Plastic Molding Machine Div., 2685 E. 79th St., Cleveland 4, Ohio
Watson-Stillman Press Div., Farrel-Birmingham Co., Inc., 265 Blossom Road, Rochester 10, New York

** Casting area is dependent on the injection pressure used for the different materials in relation to the clamping capacity of the platens, and the mold construction.

*** Plasticizing capacity varies broadly with material selection, part design, injection speed, and mold cooling.

\# Despite repeated requests for data on their machines, material was not received in time for inclusion in this tabulation.

\## Has more machines in addition to tabulated models.

\### Delivery time, as well as prices, should be substantiated in a formal quotation from the manufacturer.

HPM** (Cont'd.)

Impco**

Manufacturer*	HPM** (Cont'd.)				Impco**					
Machine model	350-HV-12/16	350-P-28	450-HV-32/42	650-P-80	CB30-75	HA2 125	HA4 - 175	HA8-275	HEL2-300	HA16-425
Machine action	Automatic and Semi-automatic				Auto.	Automatic, Semi-automatic, or Manual				
Machine type	Horiz. Hydr.	Horiz. Hydr.	Horiz.. Hydr.	Horiz. Hydr.	Horiz. Toggle	Horiz. Hydr.	Horiz. Hydr. & Toggle	Horiz. Hydr.	Horiz. Hydr. & Toggle	Horiz. Toggle
Clamping mechanism										
Injection capacity, oz./shot	12/16	28	32/42	80	50 gms.	2 - 3	4 - 6	8 - 10	12 - 16	20
Casting area, sq. in.**	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Injection plunger stroke, in.	12	10	15	12	Pressurized valve injector.	6	8 - 11	9	12	20
Plunger speed, in./min.	160	247	158	210	- - -	- - -	- - -	- - -	- - -	- - -
Pressure on material, psi.	20,000	20,000	20,000	20,000	22,500	20,000	21,750	23,000	22,400	23,200
Injection rate, lbs./hr.	1,230*	1,230*	2,510*	2,435*	Indeterminate	750#	435#	860#	645#	1,700#
Plasticizing capacity, lbs./hr.***	150	150	300	200	60	75	75	100	120	200
Cycles/hour	- - -	- - -	- - -	- - -	1,500 Dry	950 Dry	660 Dry	750 Dry	420 Dry	720 Dry
Mold: Size, in.	20 x 34V 34 x 20H	20 x 34V 34 x 20H	30 x 48V 48 x 30H	30 x 48V 48 x 30H	Special	10 x 14	13 x 20	16 x 25	19 x 25	24 x 26½
Daylight opening, in.	34	34	50	50	Special	30	22-3/4	32½	30½	49½
Thickness (min.-max.), in.	8 - 17	8 - 17	12 - 25	12 - 25	Special	9 - 15	5 - 13-3/4	6 - 18	8 - 18	10 - 25
Locking force, tons	350	350	650	650	75	125	175	275	300	425
Clamping stroke (min.-max.), in.	0 - 22	0 - 22	0 - 30	0 - 30	9 adj.	3 - 15	5 - 9	5 - 14½	5½ - 12½	6 - 24½
Clamp tie bars or rods: Diameter in.	5	5	6½	6½	3½	2½	2-3/4	3-3/4	4	4-3/4
Space between (V x H), in.	20½ x 20½	20½ x 20½	30½ x 30½	30½ x 30½	Special 13 x 10	7½x10-1/8	13½ x 12½	16-3/4 x 15½	19½ x 16	26-3/4 x 24½
Hopper capacity, lbs.	125	125	200	200	25	110	110	110	110	110
Cylinder heating capacity, kilowatts	25	35.4	37.6	50.9	10	13	11	13.5	16	20
Motor hp.	60	60	107.5	107.5	15	30	20	30	30	60
Oil tank or reservoir capacity, gals.	150	150	400	400	30	60	60	75	110	75
Special features	Rotary valve preplasticizing unit with positive shot-measurement.				Photo-elec. recycling. Adj. knock-out. Electronic timers. Pre-pressurized molding. Proportional heating on cylinder.	Low-pressure closing.		Adjustable knock-out. Volume feed. Proportional heating on cylinder. Multiple nozzles. Feed baffle arrangement.		
Optional features	Low-pressure mold closing protection. Booster power unit for nylon molding. Proportional-type temp. control for nozzle. Weigh-feeder.		Weigh-feeder.		Special elec. props. and special cycles can be provided. Pre-pressurized molding. 2-stage injection.					
Approx. delivery time, weeks###	Immediate delivery on most models.				- - -	- - -	- - -	- - -	- - -	- - -

* Cubic inches/minute

\# Cubic inches/minute

Lester**

Lombard

Manufacturer*	Lester**						Lombard		
Machine model	L-2B-4/6	L-225-6/9	L-2A-8	L-2-12	L-2-20	L-450-24/32	2414-6	3214-12	3220-125
Machine action	Auto.	Auto.	Semi-auto.	Semi-auto.	Auto.	Auto.	Auto., Semi-auto, or Manual		
Machine type	Horiz.	Horiz.	Horiz.	Horiz.	Horiz.	Horiz.	Horiz.	Horiz.	Horiz.
Clamping mechanism	Toggle	Toggle	Toggle	Toggle	Toggle	Toggle	Toggle	Toggle	Toggle
Injection capacity, oz./shot	4 - 6	6 - 9	8	12	20	24 - 32	6	12	12
Casting area, sq. in.**	50	- - -	110 (on 20,000 psi.)	135 (on 20,000 psi.)	200 (on 21,000 psi.)	- - -	110	165	165
Injection plunger stroke, in.	6-5/8	7½	10	14	13-1/8	7.5	10	12	12
Plunger speed, in./min.	246	375##; 188###	171	171	150	192##; 96###	430##; 226###	320##; 156###	410##; 202###
Pressure on material, psi.	20,000	20,000	20,000	20,000	21,000	20,000	20,000max.	20,000max.	30,500 max.
Injection rate, lbs./hr.	678#	#1,570##; # 792###	720#	720#	1,056#	#2,880##; #1,440###	1,710##; 900###	2,260##; 1,110###	2,900##; 940###
Plasticizing capacity, lbs./hr.***	- - -	- - -	- - -	- - -	- - -	- - -	150	150	150
Cycles/hour	approx.767 (idling)	approx.857 (idling)	approx.410 (idling)	approx.300 (idling)	approx. 260 (idle)	approx.497 (idling)	900 Dry	520 Dry	700 Dry
Mold: Size, in.	13-3/4x19½	16½ x 31½	23x31-3/4	25-3/4x28	28 x 40	26-3/4x38	14-7/8x28	20 x 36	20 x 36
Daylight opening, in.	21 max.	38 max.	26 max.	28 max.	35 max.	60 max.	32 max.	36 max.	42 max.
Thickness (min.-max.), in.	9 - 12	7 - 22	13 - 16	13 - 16	15 - 21	9 - 30	6 - 18	8 - 22	8 - 22
Locking force, tons	150	225	300	400	600	450	215	325	325
Clamping stroke (min.-max.), in.	6 - 9	8 - 16	10	12	14	8 - 30	6 - 14	8 - 14	8½ - 20
Clamp tie bars or rods: Diameter in.	3½	5-3/8	6½	6½	8	7½	3½	4	4
Space between (V x H), in.	14 x 12	17-3/8x20	23½ x 18½	26 x 18½	28½ x 26	27 x 25	15 x 15	20½ x 20½	20½ x 20½
Hopper capacity, lbs.	45	50	55	100	125	175	100	100	100
Cylinder heating capacity, kilowatts	10	17.2	11.1	14	17.25	27.5	25.5	24.4	25.5
Motor hp.	25	30	30	30	50	50	25	30	50
Oil tank or reservoir capacity, gals.	125	80	130	137	190	160	100	150	150
Special features	Compensating feed mechanism. Nylon molding. Low press.closing. Auto. cycling. 2-point ejection. Stuffer.	Retractable inj. end. Stuffer. Diff. system for opening, closing, & inj. Low-pressure closing. 2-point ejection.	Compensating feed mechanism for nylon molding. 2-point ejection. Plunger advance.			Retractable inj. end. Stuffer. Diff. system for opening, closing, & inj. Low-pressure closing.	Stuffing arrangement. Low-pressure die closing.	Stuffing arrangement. Plunger advance controls. Hydr. positioning of injection & linkage units. Hi-speed plunger prefill. Dual inj. pressure controls. Water-cooled plunger. Auto. lubrication.	
Optional features	Pneumatic die wipers	Mold overload compensator. Outside ejec.	Auto. cycling available. Pneumatic die wipers. Outside ejection available.			Mold overload compensator. Outside ejec.	(See next page)		
Approx. delivery time, weeks##	- - -	- - -	- - -	- - -	- - -	- - -	- - -	2	2

\# Cubic inches/min. ##During rapid advance. ###During final fill.

& ### See next page.

Manufacturer*	Lombard (Cont'd.)		Moslo						Natco	
Machine model	3220-16	3624-18	74-7-2 & 74-12-2	75-8-4/6	75-15-4/6	76-8-4/6	Duplimatic Model 11	Duplimatic Model 12	300	400
Machine action	Auto., Semi-auto., or Manual		Auto.	Auto.	Auto.	Auto.	Semi-auto.	Semi-auto.	Semi-auto.	Semi-auto.
Machine type	Horiz. Toggle	Horiz. Toggle	Horiz. Toggle	Horiz. Toggle	Horiz. Toggle	Horiz. Toggle	Vertical Toggle	Vertical Toggle	Horiz. Hydr.	Horiz. Hydr.
Clamping mechanism									Single/double feed	
Injection capacity, oz./shot	16	18	2	4 - 6	4 - 6	4 - 6	3	4 - 6	22 - 30	28 - 34
Casting area, sq. in.**	165	225	24, 20	54	50	54	20 max.	40 max.	Depends on part design & plastic material used	
Injection plunger stroke, in.	12	12½	5½	8	8	8	8	8	15	15
Plunger speed, in./min.	320###; 117###	408###; 151###	254#	149#	149#	178#	153#	178#	160	119
Pressure on material, psi.	20,000 max.	20,000 max.	16,550 max.	20,000 max.	20,000 max.	20,000 max.	17,550 max.	20,000 max.	20,000	20,000
Injection rate, lbs./hr.	3,080##; 1,130###	3,920##; 1,450###	378#	468#	468#	560#	317#	560#	1,125#	1,140#
Plasticizing capacity, lbs./hr.***	200	200	60	70	70	90	50	70	130	165
Cycles/hour	420 (Dry)	500 (Dry)	1,300, 1,000 (Dry)	700 (Dry)	580 (Dry)	780 (Dry)	450 (Dry)	690 (Dry)	(See below)	
Mold: Size, in.	20 x 36	23-3/4x38	9-7/8x15½	11-7/8x15	11-7/8x15	11-7/8x15	6 x 8 (top) 6x17(bottom)	8x10 (top) 8x21½(bottom)	33x21½ max.	38x24-3/4 max.
Daylight opening, in.	42 max.	50 max.	7, 12	8	15	8	2½	5	32-41½max; 8-19½ min.	38-50max; 12-24 min.
Thickness (min.-max.), in.	8 - 22	8 - 26	5½ - 12	8 - 15	8 - 15	8 - 15	3 - 3½	5 - 5		
Locking force, tons	325	450 max.	70	135	135	150	75	90	325	425
Clamping stroke (min.-max.), in.	8½ - 20	8 - 24	7, 5½-12	8	8 - 15	8	2½	5		
Clamp tie bars or rods: Diameter, in.	4	4½	2	2½	2½	2½	- - -	- - -	4½	5
Space between (V x H), in.	20½ x 20½	23-7/8 x 21-7/8	7½ x 10	11x12-1/8	11x12-1/8	11x12-1/8	- - -	- - -	21½ x 21½	25 x 25
Hopper capacity, lbs.	100	100	75	75	75	75	75	75	100	200
Cylinder heating capacity, kilowatts	25.5	25.5	6	7	7	8	6	7	16	24
Motor hp.	30	50	7½	10	10	15	5	15	47½ total	47½ total
Oil tank or reservoir capacity, gals.	150	150	58	77	77	90	90	77	175	175
Special features	(See preceding page)		Heat controls on cylinder & nozzle. Modified J.I.C. control circuit. Plug-in temperature and timer controls.				Shifting table for dual lower mold platen permits two-section molding & continuous operation.		(See below)	
Optional features	Weigh-feed. Lo-press. mold closing. Pre-compressed molding unit. Hi-speed inj. unit. Nylon shut-off valve. 2-4 nozzle attachments. Mold stop control&slow-down. Core pulling attach. Auto. door opener.		70-lb. plasticizing cyl.	90-lb. plasticizing cylinder.			Low-press. close. Inj. ram control. Secondary injection pressure.		(See below)	
			Inj. ram control. Secondary injection pressure.							
			Oil immersed solenoids on all directional valves.							
Approx. delivery time, weeks##	2	- - -	3	4 - 6	4 - 6	4 - 6	3	4 - 6		

Cu. in./min. during prefill or approach.
Cu. in./min. while injecting.

Cubic inches per minute.

Cubic inches/minute

Manufacturer*	Natco (Cont'd.)				Reed-Prentice**					
Machine model	400-S	400-X	800	800-X	175T-4/6	Jetflo	275T-8/10	320TC-12/16	450T-20/24	600T-32/48
Machine action	Semi-auto.	Semi-auto.	Semi-auto.	Semi-auto.	Auto.	Auto.	Semi-auto.	Semi-auto.	Semi-auto.	Semi-auto.
Machine type	Horiz. Hydr.	Horiz. Hydr.	Horiz. Hydr.	Horiz. Hydr.	Horiz. Toggle	Horiz. Toggle	Horiz. Toggle	Horiz. Toggle	Horiz. Toggle	Horiz. Toggle
Clamping mechanism	Single/double feed									
Injection capacity, oz./shot	28 - 34	28 - 34	85 - 100	85 - 100	4 - 6	6	8 - 10	12 - 16	20 - 24	32 - 48
Casting area, sq. in.**	Depends upon part design and plastic material used				75	75	125	150	200	300
Injection plunger stroke, in.	15	15	21	21	8-7/8	6	11	11-3/4	13	10
Plunger speed, in./min.	119	252	102	204	155;312#	360;1,200#	148;329#	170;303#	100;267#	58.1;117#
Pressure on material, psi.	20,000	20,000	20,000	20,000	17,800	17,000	20,000	20,000	21,000	19,350
Injection rate, lbs./hr.	1,140#	2,420#	2,000#	4,000#	492##	1,160##	801##	1,360##	962##	1,450##
Plasticizing capacity, lbs./hr.***	165	165	350	350	75	100	120	150	150	180
Cycles/hour	Estimated cycle time furnished upon receipt of plastic part specification.				600 max*	1,242 max.*	470 max.*	535 max.*	200 max.*	172 max.*
Mold: Size, in.	38x24-3/4 max.	38x24-3/4 max.	55x36½ max.	55x36½ max.	22 x 13½	22 x 13½	27½ x 15½	32½ x 20½	45 x 25½	54 x 30½
Daylight opening, in.	36-48 max; 10-22 min.	38-50 max; 12-24 min.	55-85 max; 15-45 min. (In 5-inch Increments.)	55-85 max; 15-45 min. (In 5-inch Increments.)	22	22	27-3/4	36½	40	56
Thickness (min.-max.) in.					6 - 14	6 - 14	6½ - 16½	8 - 20	7 - 24	12 - 32
Locking force, tons	550	425	850	850	175	175	275	350	450	600
Clamping stroke (min.-max., in.	26	26	40	40	5 - 8	5 - 8	6½ - 11½	7½ - 14½	16 max.	24
Clamp tie bars or rods: Diameter, in.	6	5	7	7	3	3	3½	4	5	6
Space between (V x H), in.	25 x 22	25 x 25	36½ x 36½	36½ x 36½	13½ x 13½	13½ x 13½	15½ x 15½	20½ x 20½	22½ x 25½	26½ x 30½
Hopper capacity, lbs.	200	200	500	500	100	150	150	150	150	150
Cylinder heating capacity, kwts.	24	24	40	40	13.6	15.4	17.0	21.7	30.3	24.1
Motor hp.	47½ total	87½ total	82½ total	157½ total	15	40	25	40	40	50
Oil tank or reservoir capacity, gals.	260	260	550	550	80	100	150	155	150	200
Special features	Water-cooled plunger. Adjustable two-speed, two-pressure injection. Prepack and preposition. Vibratory feed. Signal lights for heater bands. Reversing-type pump with shockless system.				2-stage injection. Built-in stuffing.	Lo-pressure mold closing.	Two-stage injection. Built-in stuffing.			
					Automatic ejection. Zoned temperature control. Adjustable mold stroke					
Optional features	Weigh feeder. Nozzle for nylon molding. Plunger & feed bushing for 17,500 or 30,000 psi. pressure. Automatic cycle control with low-pressure mold protection.				Larger heating cyl.	- - -	Larger heating cyl.			
					Lo-press. die closing.					
					Nylon molding equipment.					
								Long stroke model 8½ to 20½ in.		
					Long stroke up to 12 in.					
Approx. delivery time, weeks##	Built in stock quantities for prompt delivery.				- - -	- - -	- - -	- - -	- - -	- - -

With prefill. ## Displacement rate. *Full stroke.

Manufacturer*	Standard Tool			Stokes			Van Dorn		
Machine model	Automolder SP20-25-T	Automolder SP-20-100-TA	Automolder SP-20-100-TB	701	700	703	H-200	H-250	H-260
Machine action	Auto.	Auto.	Auto.	Auto.	Auto.	Auto.	Semi-auto.	Auto.	Auto.
Machine type	Horiz.	Horiz.	Horiz.	Vert.Clamp	Horiz. (Straight	Vert.Clamp	Horiz.	Horiz.	Horiz.
Clamping mechanism	Hydr.	Hydr.	Hydr.	Toggle	Hydr.	Toggle	Toggle	Toggle	Toggle
Injection capacity, oz./shot	2	2	2	2	4	6	2	2½	2½
Casting area, sq. in.**	20	40	60	20	48	100	20	20 plus	20 plus
Injection plunger stroke, in.	4	4	4	4½	8	9	7	7	7
Plunger speed, in./min.	Approx. 2.5###	Approx. 2.5###	Approx. 2.5###	200	360	260	225	270	270
Pressure on material, psi.	14,000-26,000	14,000-26,000	14,000-26,000	12,100	16,000	19,600	10,000	12,000	12,000
Injection rate, lbs./hr.	390##	390##	390##	40	60	90	12	22	30
Plasticizing capacity, lbs./hr.***	30;40	30;40	30;40	45	60	90	12	22 plus	30 plus
Cycles/hour	1,200(dry)	2,000(dry)	2,000(dry)	1,030	515	495	480-600	720 max.	720 max. (dry)
Mold: Size, in.	9x10 max.	9x10 max.	9x10 max.	16 x 8½	21 x 12	23½ x 16	9x12 max.	9x12 max.	9x12 max.
Daylight opening, in.	12-3/4 max.	18 max.	12-3/4max.	14 - 20½	21-3/4	26 - 34	6	6	6
Thickness (min.-max.),	6 min.	9 min.	6 min.	8½ - 15	8- 13-3/4	28½ - 36½	3 x 8½	3 x 8½	3 x 8½
Locking force, tons	25	100	100	50	120	250	30	30	30
Clamping stroke (min.-max.), in.	0 - 6-3/4#	0 - 6-3/4#	0 - 9#	5½	14	12	6#	6#	6#
Clamp tie bars or rods: Diameter, in.	- - -	- - -	- - -	1 - 3/4	3½	4½	1 - 3/4	1 - 3/4	1 - 3/4
Space between (V x H), in.	9-3/8x12	9-3/8x12	9-3/8x12	17 - 3/4 x 6 - 3/4	12 x 12	24 x 10	9	9	9
Hopper Capacity, lbs.	125	125	125	30	60	85	6	40	40
Cylinder heating capacity, kwts.	3.15	7.9	7.9	5.4	6	17.3	1.68	2.6	3.135
Motor hp.	15	15	15	7½	15	20	5	7½	7½
Oil tank or reservoir capacity, gals.	60	60	60	70	40	150	20	20	20
Special features	Heat controls. Instrument stand. Cam-operated, mechanical drive for timing. Third pyrometer for hot-runner molds. Lo-pressure closing. Auxiliary air sweep to aid positive ejection. →			Injection nozzle shut-off. Prepack. Positive ejection. →			Automatic part ejector. Oil cooler and cylinder heater. → Adj. material metering. Oversize heater. →	Low-pressure clamping. →	Extended nozzle. Can mold vinyls.
							Adjusts to varying mold thicknesses. → Repeat cycle timer. →		
Optional features				None required. →			Repeat cycle timer. → Can mold vinyls. →		
Approx. delivery time, weeks##	4 - 5	4 - 5	4 - 5	3-4 Aver.	3-4 Aver.	- - -	4 - 6	4 - 6	4 - 6

\# Controlled by die height or by insertion of spacer blocks.
Cubic in./minute.
Inches per second.

\# Not adjustable.
Adjustable.
At full pressure.

Manufacturer*	Van Dorn (Cont'd.)		Watson-Stillman**					
Machine model	H-300	H-400	5ES-215	10ES-300	16ES-400S	24ES-650	32ES-650	48ES-1000
Machine action	Auto.	Auto.	Manual Semi-auto. & Auto.	Manual Semi-auto. & Auto.	Manual & Semi-auto.	Manual & Semi-auto.	Manual & Semi-auto.	Manual & Semi-auto.
Machine type	Horiz.	Horiz.	Horiz.	Horiz.	Horiz.	Horiz.	Horiz.	Horiz.
Clamping mechanism	Toggle	Toggle	Hydr.	Hydr.	Hydr.	Hydr.	Hydr.	Hydr.
Injection capacity, oz./shot	3	4	5 max.	10 max.	16 max.	24 max.	32 max.	48 max.
Casting area, sq. in.**	- - -	75 - 150	107	150	200	292	325	500
Injection plunger stroke, in.	7	7	9	12	12	14½	14½	18½
Plunger speed, in./min.	300	175##	205;550##	210;400##	195;400##	174;400##	130;400##	200;325##
Pressure on material, psi.	20,000	20,000	20,000	20,000	22,500	20,000	20,000	21,000
Injection rate, lbs./hr.	75	100	1,160#	1,240#	1,518#	1,800#	1,737#	3,360#
Plasticizing capacity, lbs./hr.***	65	100	80	140	150	250	300	500
Cycles/hour	1,100 max. (dry)	840max. (dry)	600	550	480	410 max.	350 max.	300 max.
Mold: Size, in.	12x18 max.	13-3/8 x 23½ max.	15-3/4 x 25½ max.	20½ x 36 max.	20x36max.& 21x33 max.	30½ x 48	27x45max.& 27 x 3½	40 x 60
Daylight opening, in.	4-8;4-12	- - -	24 - 30	30	34	54	54	66
Thickness (min.-max.), in.	4-12;6-14	6 - 16	12 min.	12 min.	12 min.	12 min.	12 min.	12 min.
Locking force, tons	85, 100	175	215	300	400	650	650	1,000
Clamping stroke (min.-max.), in.	4 - 8##	4 - 10#	12 max.	18 max.	22 max.	30 max.	30 max.	36 max.
Clamp tie bars or rods: Diameter, in.	2½	2 - 3/4	3/4	4	4½	6	6	7½
Space between (V x H), in.	12-1/8 x 10-1/8	13½x12-1/8	15-3/4x 15-3/4	20½ x 20½	20 x 21	30½ x 30½	27 x 27	40 x 40
Hopper capacity, lbs.	45	65	50	100	150	200	200	250
Cylinder heating capacity, kwts.	- - -	- - -	9.8	12	20.65	24.2	29	52.3
Motor hp.	15	20	50	50	70	70	70	135
Oil tank or reservoir capacity, gals.	60	80	100	150	240	260	260	540
Special features	Automatic part ejector. Oil cooler & cylinder heater. Adj. material metering. Oversize heater. → Can mold vinyls. → Adjusts to varying mold thicknesses. → One-shot lubrication system. → Four tie-bar construction. Repeat cycle timer. →		Low-pressure die closing. → Adjustable slow-down on clamping stroke. → Pre-positioning of injection ram. → Stuffer circuit by selector switch. →					
	8-inch stroke.	Double toggle lock. Stuffing arrangement.						

Manufacturer*	Van Dorn (Cont'd.)		Watson-Stillman** (Cont'd.)						
Machine model	M-300	M-400	2ES-215	10ES-300	16ES-400S	24ES-650	32ES-650	48ES-1000	
Optional features	Repeat cycle timer. Can mold vinyls. 4-12 in. adjustable stroke. Weirh feeder. Low-pressure closing.		Pre-plasticizing unit can be added. Weirh-feeders.			Low-pressure die closing.			
Approx. delivery time weeks#,##	4 - 6	4 - 6	3 - 4	6 - 8	3 - 4	2 - 4	2 - 4	8 - 10	
*, **, *** Same as preceding page.			# Cubic inches per minute. ##Plunger return.						

PT's classified list of auxiliary equipment for injection molding

Blenders

Abbe Engineering Co., 420C Lexington Avenue, New York 17, N.Y.
Paul O. Abbe, Inc., 257 Center Avenue, Little Falls, New Jersey
Acme Machinery & Mfg. Co., Inc., 20 South Broadway, Yonkers 2, New York
Blaw-Knox, 300 Sixth Avenue, Pittsburgh 22, Pennsylvania
The Bonnot Co., 722 Mulberry Avenue, S.E., Canton 2, Ohio
Arthur Colton Co., Div. of Snyder Corp., 3400 E. Lafayette St., Detroit 7, Mich.
Crown Machinery Inc., 2721 S. San Pedro St., Los Angeles 11, Calif.
J. H. Day Co., Div. of Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, Ohio
J. P. Devine Mfg. Co., 49th St. & A.V.R.R., Pittsburgh 1, Pa.
Entoleter Div., Safety Industries, Inc., 1187 Dixwell Ave., New Haven, Conn.
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Ferro Corp., Patterson Equipment Div., E. Liverpool, Ohio
First Machinery Corp., 209-289—10th Street, Brooklyn 15, New York
Lupoline Automatic Polishing Equipment Corp., 4510 Bullard Ave., Bronx 70, N.Y.
Manton-Gaulin Mfg. Co., Inc., 44 Garden Street, Everett 49, Mass.
Mitchell Specialty Div., Industrial Enterprises, Inc., Edmund & Shelmire Sts., Phila. 36, Pa.
Munson Mill Machinery Co., 210 Seward Ave., Utica 1, New York
Patterson Foundry and Machine Co., 1250 St. George St., E. Liverpool, Ohio
Patterson-Kelley Co. Inc., E. Stroudsburg, Pa.
Plastic Molders Supply Co., Inc., 74 South Avenue, Fanwood, N.J.
Prodex Corp., King George Road, Fords, New Jersey
Rainco Mfg., Inc., R.D. #2, Franklin, Pa.
The Rainville Co., Inc., 839 Stewart Avenue, Garden City, New York
Read Standard, Div. of Capitol Products Corp., 901 S. Richland Ave., York, Pa.
Reliable Rubber & Plastic Machinery Co., Inc., 2014 Union Turnpike, No. Bergen, N.J.
Charles Ross & Son Co., 148 Classon Ave., Brooklyn 5, N.Y.
Sprout, Waldron & Co., Inc., 130 Logan Street, Muncy, Pa.
Sturtevant Mill Co., 103 Clayton Street, Boston, Mass.
Tower Iron Works, Inc., 50 Borden Street, Providence, R.I.
Young Machinery Co., Inc., R.D. #2, Muncy, Pa.

Conveyors

Abbott Plastic Machine Corp., 7124 N. Clark Street, Chicago 26, Ill.
E. B. Blue Co., 651 Connecticut Ave., S. Norwalk, Conn.
Carpco Mfg., Inc., 4120 Haines St., Jacksonville 6, Fla.
Chain Belt Co., 4701 W. Greenfield Ave., Milwaukee 1, Wis.
D. C. Cooper Co., 1467 S. Michigan Ave., Chicago 5, Ill.
The J. H. Day Co., Div. of Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, O.
Dean Panel Coil, Dean Products, Inc., 1048 Dean St., Brooklyn 38, N.Y.
Dracco Div. of Fuller Co., 4063 E. 116th St., Cleveland 5, Ohio
Frank W. Egan & Co., 671 S. Adamsville Rd., Somerville, N.J.
Vern Emery Co., 10647 Wixom St., Sun Valley, Calif.
The Falls Engineering & Machine Co., 1734 Front St., Cuyahoga Falls, Ohio
Ferry Machine Co., W. Main Street Extension, Kent, Ohio
Herbert Products, Inc., 74-32 Jamaica Ave., Woodhaven 11, New York
Indiana Commercial Filter Corp., Lebanon, Ind.
Island Equipment Corp., 1090 E. 31st Street, Hialeah, Fla.
Jennings Engineering Co., 3444 Ludlow St., Philadelphia 4, Pa.
Karlton Machinery Corp., 210 E. Ohio St., Chicago 11, Ill. (Rep. for Becker & Van Hullen)
L & P Tool Co., 2861 Sidney Ave., Cincinnati 25, Ohio
Leon Machine & Engineering Co., 61 Whittaker St., Riverside, N.J.
Magnetic Engineering & Mfg. Co., 851 Van Houten Ave., Clifton, N.J.
Mercury Heat Sealing Equipment Co., 2601-21 N. Howard St., Philadelphia 33, Pa.
Mitchell Specialty Div., Industrial Enterprises, Inc., Edmund & Shelmire Sts., Phila. 36, Pa.
Modern Plastic Machinery Corp., 64 Lakeview Avenue, Clifton, N.J.
Motch & Merryweather Machinery Co., 1258 E. 222nd St., Cleveland 17, Ohio
National Rubber Machinery Co., 47 W. Exchange St., Akron 8, Ohio
The Oliver Corp., A. B. Farquhar Div., 142 N. Duke St., York, Pa.
Omni Products Corp., 460 Fourth Avenue, New York 16, N.Y.
Plastic Fabricants, Div. of The Woodman Co., Inc., 647 E. College Ave., Decatur, Ga.
Prodex Corp., King George Road, Fords, New Jersey
Pulverizing Machinery Div., Metals Disintegrating Co., Inc., 30 Chatham Rd., Summit, N.J.
Read Standard, Div. of Capitol Products Corp., 901 S. Richland Ave., York, Pa.
Robinson Air-Activated Conveyor Systems, 80 Fifth Avenue, New York 11, New York
Spencer Turbine Co., 486 New Park Ave., Hartford 6, Conn.
Sprout, Waldron & Co., Inc., 130 Logan Street, Muncy, Pa.
Standard Conveyor Co., 315 N.W. 2nd Street, St. Paul 9, Minn.
Sterling Extruder Corp., 1112 Baltimore Ave., Linden, New Jersey
Syntron Co., P.O. Box 2200, Homer City, Pa.
Tote System, Inc., 710 S. Seventh, Beatrice, Neb.
Union Tool Corp., 900 N. Detroit St., Warsaw, Ind.
John Verduin Machine Corp., 345-357 Tenth Ave., Paterson 4, New Jersey
John Waldron Corp., P.O. Box 791, River Rd., New Brunswick, N.J.
L. R. Wallace & Co., 172 N. Vernon Ave., Pasadena 1, Calif.
Douglas C. Whitaker Co., Box 271, Glenside, Pa.
Whitlock Associates, Inc., 21655 Coolidge Highway, Oak Park 37, Mich.
Wilkinson Co., 619 E. Tallmadge Ave., Akron 10, Ohio
Young Machinery Co., Inc., R.D. #2, Muncy, Pa.

Deflashing Machines

Anson Tools & Gages, Inc., 1504 W. 12th Street, Erie, Pa.
Buttondex Corp., 386 Fourth Avenue, New York 16, New York
Falls Engineering & Machine Co., 1734 Front St., Cuyahoga Falls, Ohio
Ferry Machine Co., W. Main Street Extension, Kent, Ohio
Foredom Electric Co., Inc., Bethel, Conn.
Gaynes Engineering Co., 1642 W. Fulton St., Chicago 12, Ill.
Ketchpel Engineering Co., 1401-04 Palisade Avenue, W. Englewood, N.J.
H. W. Kramer Co., Inc., 120-30 Jamaica Ave., Richmond Hill 18, N.Y.
Lord Chemical Corp., 2068 S. Queen Street, York, Pa.
Lupoline Automatic Polishing Equipment Corp., 4510 Bullard Ave., Bronx 70, N.Y.
Merit Products, Inc., 3691 Lenawee Ave., Los Angeles 16, Calif.
J. M. Nash Co., Inc., 2360 N. 30th St., Milwaukee 45, Wis.
Ransohoff Co., North 5th St. & Ford Blvd., Hamilton, Ohio
The R. R. Siebert Co., 183 St. Paul St., Rochester, N.Y.
Techline Div., Wheelabrator Corp., 1414 Avenue V, Vicksburg, Mich.
Tumb-L-Matic, Inc., St. Mary's Street, Stamford, Conn.
Wheelabrator Corp., 1414 S. Byrkit St., Mishawaka, Indiana

Degating Equipment

Anson Tools & Gages, Inc., 1504 W. 12th Street, Erie, Pa.
Atlas Machine & Tool Corp., 259 Hackensack St., East Rutherford, N.Y.

Barker-Davis Machine Co., Inc., 91 Mechanic Street, Leominster, Mass.
Buss Machine Works, Inc., 300 Eighth Street, Holland, Michigan
Buttondex Corp., 386 Fourth Avenue, New York 16, New York
Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio
C. A. Lawton Co., 233 No. Broadway, DePere 1, Wisconsin
Plastic Molders Supply Co., Inc., 74 South Ave., Fanwood, N.J.
Standard Tool Co., 203 Hamilton Street, Leominster, Mass.
Sta-Warm Electric Co., 858 N. Chestnut St., Ravena, Ohio
Stricker-Brunhuber Corp., 19 W. 24 St., New York 10, New York
Techline Div., Wheelabrator Corp., 1414 Avenue V, Vicksburg, Mich.

Dicers & Choppers

Abbe Engineering Co., 420C Lexington Avenue, New York 17, N.Y.
Acme Machinery & Mfg. Co., Inc., 20 South Broadway, Yonkers 2, New York
Aetna-Standard Div., Blaw-Knox Co., c/o Hale & Kullgren, Inc., P.O. Box 1231, Akron 9, Ohio
Alsteele Engineering Works, Inc., 82 Herbert St., Framingham, Mass.
American Pulverizer Co., 1249 Macklind Ave., St. Louis 10, Mo.
Atlas-Sandt Corp., 240-42 W. 23 St., New York 11, New York
Ball & Jewell, Inc., 24-28 Franklin St., Brooklyn 22, N.Y.
Blaw-Knox Co., 300 Sixth Avenue, Pittsburgh 22, Pa.
Brosites Machine Co., Inc., 50 Church St., New York 7, N.Y.
Carbert Mfg. Co., Inc., 143 Sidney St., Cambridge 39, Mass.
Arthur Colton Co., Div. of Snyder Corp., 3400 E. Lafayette St., Detroit 7, Michigan
Continental Machinery Co., Inc., 261 Broadway, New York 7, N.Y.
Cumberland Engineering Co., Inc., P.O. Box 216, Providence, R.I.
Custom Machine & Design, Inc., P.O. Box 1064, 200 S. Forge St., Akron 9, Ohio
DeMattia Machine & Tool Co., Brighton & Chelsea Rd., Clifton, N.J.
Ferry Machine Co., W. Main St. Extension, Kent, Ohio
Foster & Allen, Inc., 26 Commerce St., Chatham, N.J.
Hale & Kullgren, Inc., 613 E. Tallmadge Ave., Box 1231, Akron, Ohio
Hobbs Mfg. Co., 26 Salisbury St., Worcester 5, Mass.
Johnson Machinery Co., 683 Frelinghuysen Ave., Newark 5, N.J.
Mitts & Merrill, 1016 S. Water St., Saginaw, Michigan
Franklin P. Miller & Son, 36 Meadow St., E. Orange 16, New Jersey
Modern Plastic Machinery Corp., 15 Union St., Lodi, New Jersey
Motch & Merryweather Machinery Co., 1258 E. 222nd St., Cleveland 17, Ohio
Omni Products Corp. 460 Fourth Avenue, New York 16, New York
Radial Cutter Mfg. Corp., 831 Bond St., Elizabeth 4, New Jersey
The Rainville Co., Inc., 839 Stewart Ave., Garden City, New York
Spadone Machine Co., Inc., Connecticut Avenue, S. Norwalk, Conn.
Sprout, Waldron & Co., Inc., 130 Logan St., Muncy, Pa.
Taylor Stiles & Co., 13 Bridge St., Riegelsville, N.J.
Thoreson-McCosh, Inc., 18208 McNichols Rd., Detroit 19, Mich.
The Van Dorn Iron Works Co., 2685 East 79th St., Cleveland, Ohio

Dryers, Non-Oven

Paul O. Abbe, Inc., 257 Center Ave., Little Falls, N.J.
Ball & Jewell, Inc., 24-28 Franklin St., Brooklyn 22, N.Y.
The Black-Clawson Co., Dilts Div., 46 N. First St., Fulton, New York
Blaw-Knox Co., 300 Sixth Avenue, Pittsburgh 22, Pa.
E. B. Blue Co., 651 Connecticut Avenue, S. Norwalk, Conn.
Carpco Mfg., Inc., 4120 Haines St., Jacksonville 6, Florida
Continental Machinery Co., Inc., 261 Broadway, New York 7, New York
F. C. Dawson Engineering Co., 641 Washington St., Canton, Mass.
Dean Panel Coil, Dean Products, Inc., 1048 Dean St., Brooklyn 38, New York
The DeVilbiss Co., 300 Phillips Ave., Toledo 1, Ohio
J. P. Devine Mfg. Co., 49th St. & A.V.R.R., Pittsburgh 1, Pa.
J. E. Doyle Co, 1220 W. Sixth St., Cleveland 13, Ohio
Dryomatic Corp., 806 N. Fairfax St., Alexandria, Va.
Falcon Equipment Co., 13th St., New Brighton, Pa.
The Fostoria Pressed Steel Corp., 1200 N. Main St., Fostoria, Ohio
General Research & Supply Co., 572 S. Division Ave., Grand Rapids 3, Mich.
Girdler Process Equipment Div., Chemetron Corp., 334 E. Broadway, Louisville 1, Ky.
Glenn Electric Heater Corp., 372 Jelliff Ave., Newark 8, N.J.
Goulding Mfg. Co., 2929 River St., Saginaw, Michigan
Guild Electronics, Inc., Dynatherm Div., 388 Broadway, New York 13, N.Y.
Herbert Products, Inc., 74-32 Jamaica Ave., Woodhaven 11, New York
Infra-Red Systems Inc., 240 Route 23, Riverdale, New Jersey
Johnson Mfg. Co., Inc., Highway 178, Chippewa Falls, Wis.
C. A. Litzler Co., Inc., 235 Brookpark Rd., Cleveland 9, Ohio
Lydon Bros., Inc., 85 Zabriskie St., Hackensack, N.J.
Miskella Infra-Red Co., Inc., E. 73rd & Grand Ave., Cleveland 4, Ohio
Mitchell Specialty Div., Industrial Enterprises, Inc., Edmund & Shelmire Sts., Phila. 36, Pa.
Monkley Corp., 42 Lagrange St., Worcester 8, Mass.
Moslo Machinery Co., 2443 Prospect Avenue, Cleveland 15, Ohio
Omni Products Corp., 460 Fourth Avenue, New York 16, N.Y.
Patterson Foundry and Machine, 1250 St. George St., E. Liverpool, Ohio
The Patterson-Kelley Co., Inc., E. Stroudsburg, Pa.
Proctor & Schwartz, Inc., 7th St. & Tabor Rd., Philadelphia 20, Pa.
The Rainville Co., Inc., 657 Franklin Ave., Garden City, New York
Sta-Warm Electric Co., 858 N. Chestnut St., Ravenna, Ohio
F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.
Thermomat Co. Inc., 300 Maple Avenue, Trenton 8, New Jersey
Thoreson-McCosh, Inc., 18208 McNichols Rd., Detroit 19, Mich.
Tower Iron Works, Inc., 50 Borden St., Providence, R.I.
Universal Dynamics Corp., Box 9814, Arlington 9, Va.
Douglas C. Whitaker Co., Box 271, Glenside, Pa.
Whitlock Associates, Inc., 21655 Coolidge Highway, Oak Park 37, Mich.
Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8, Pa.
Wilkinson Co., 619 E. Tallmadge Ave., Akron 10, Ohio
Wyssmont Co., Inc., 42-07D 27th Street, Long Island City 1, New York
Zack Radiant Heat Co., 23-A Vreeland St., Lodi, New Jersey

Heaters & Heating Cylinders

Atlas Machine & Tool Corp., 259 Hackensack St., East Rutherford, N.J.
Chromalox, Inc., 7506 Thomas Blvd., Pittsburgh 8, Pa.
General Electric Co., Apparatus Sales Div., 1 River Rd., Schenectady 5, N.Y.
Hotwatt, Inc., 75 Maple St., Danvers, Mass.
Industrial Heater Co., Inc., 417 Canal St., New York 13, N.Y.
Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio
New Jersey Thermex Co., Inc., 531 Bergen St., Harrison, N.J.
Thermel, Inc., 9400 Robinson Rd., Franklin Park, Ill.
Vulcan Electric Co., 88 Holten St., Danvers 32, Mass.
Watlow Electric Mfg. Co., 1376 Ferguson Ave., St. Louis 14, Mo.

Hopper Loaders

Goulding Mfg. Co., 2929 River Street, Saginaw, Michigan
Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio
Ketchpel Engineering Co., 1401-04 Palisade Ave., W. Englewood, N.J.
Omni Products Corp., 460 Fourth Avenue, New York 16, N.Y.
Rainco Mfg., Inc., R.D. #2, Franklin, Pa.
The Rainville Co., 839 Stewart Avenue, Garden City, N.Y.
Robbins Plastic Machinery Corp., 1430 Mishawaka St., Elkhart, Ind.
Spencer Turbine Co., 486 New Park Ave., Hartford 6, Conn.
Thoreson-McCosh, Inc., 18208 McNichols Rd., Detroit 19, Mich.
Whitlock Associates, Inc., 21655 Coolidge Highway, Oak Park 37, Mich.

Hydraulic Systems

Berthelsen Engineering, P.O. Box 1423, Joliet, Ill.
Clifton Hydraulic Press Co., 289 Alwood Rd., Clifton, N.J.
Consolidated Baling Machine Co., 408-L Third Ave., Brooklyn 15, N.Y.
Continental Machinery Co., Inc., 261 Broadway, New York 7, New York
Dake Corp., 641 Robbins Rd., Grand Haven, Mich.
Erie Engine & Mfg. Co., 953 E. 12th St., Erie, Pa.
French Oil Mill Machinery Co., 1040 W. Greene St., Piqua, Ohio
GPE Controls, Inc., 240 E. Ontario St., Chicago 11, Ill.
Goulding Manufacturing Co., 2929 River St., Saginaw, Mich.
Green Hydraulics, Inc., N.Y. International Airport, Jamaica 30, N.Y.
Hannifin Co., Div. of Parker-Hannifin Corp., 554D S. Wolf Road, Des Plaines, Ill.
Guy P. Harvey & Son Corp., 40 Spruce St., Leominster, Mass.
Hull-Standard Corp., Hatboro, Pa.
Hydraulic Press Mfg. Co., Div. of Koehring Co., Marion Rd., Mt. Gilead, Ohio
Johnson Machinery Co., 683 Frelinghuysen Ave., Newark 5, N.J.
Kabar Mfg. Corp., 180-B Babylon Turnpike, Roosevelt, L.I.
Karlton Machinery Corp., 210 E. Ohio St., Chicago 11, Ill. (Rep. for Becker & Van Hullen)
The C. A. Lawton Co., 233 N. Broadway, DePere 1, Wis.
Logan Hydraulics, Inc., 4901 W. Lawrence Ave., Chicago 30, Ill.
Mayflower Electronic Devices, Inc., 20 Industrial Ave., Little Ferry, N.J.
Oilgear Co., 1560 W. Pierce St., Milwaukee, Wis.
Possis Machine Corp., 1645 Hennepin Ave., Minneapolis 3, Minn.
Racine Hydraulics & Machinery, Inc., 2000 Albert St., Racine, Wis.
Rodgers Hydraulic, Inc., 7401 Walker St., Minneapolis 26, Minn.
Stanford Engineering Co., Box 329, Salem, Ill.
Ralph B. Symons Associates, Inc., 3571 Main Rd., Tiverton, R.I.
R. D. Wood Co., Public Ledger Bldg., Philadelphia 5, Pa.

Indicators, Machine Cycle

Foster & Allen, Inc., 26 Commerce St., Chatham, N.J.
The Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Industrial Nucleonics Corp., 1205 Chesapeake Ave., Columbus 26, Ohio
Minneapolis-Honeywell Regulator Co., 2753 Fourth Avenue S., Minneapolis 8, Minn.
Pratt & Whitney Co., Inc., Charter Oak Blvd., W. Hartford 1, Conn.
Seely Instrument Co., Inc., 377 Fourth St., Niagara Falls, N.Y.
Taylor Instrument Companies, 95 Ames St., Rochester 1, N.Y.

Indicators, Pressure

Fischer & Porter Co., 30 Warminster Rd., Hatboro, Pa.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia 44, Pa.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Avenue, S., Minneapolis 8, Minn.
Taber Instrument Corp., 107 Goundry St., N. Tonawanda, N.Y.
Taylor Instrument Companies, 95 Ames St., Rochester 1, N.Y.
Testing Machines, Inc., 72 Jericho Turnpike, Mineola, N.Y.
United Electric Controls Co., 85 School St., Watertown 72, Mass.
United Sensor & Control Corp., 122 Naubuc Ave., Glastonbury, Conn.
Wallace & Tiernan, Inc., 25 Main St., Belleville 9, N.J.
Weston Instruments, Div. of Daystrom, Inc., 614 Frelinghuysen Ave., Newark 12, N.J.

Indicators, Temperature

American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Barber-Colman Co., Wheelco Instruments Div., 1300 Rock St., Rockford, Ill.
Electric Auto-Lite Co., General Products Group, Champlain, Toledo 1, Ohio
Electronic Processes Corp. of Calif., 436 Bryant, San Francisco 7, Calif.
Fisher Scientific Co., 711 Forbes Ave., Pittsburgh 19, Pa.
The Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
Industrial Development Laboratories, Inc., 982 River Rd., Edgewater, N.J.
Jones Motrola Corp., 432 Fairfield Ave., Stamford, Conn.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia 44, Pa.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Avenue, S., Minneapolis 8, Minn.
Partlow Corp., 225 Campion Rd., New Hartford, N.Y.
Powers Regulator Co., 3400 Oakton St., Skokie 34, Ill.
Pyrometer Instrument Co., Inc., 92 Portland St., Bergenfield, N.J.
Pyrometer Service Co., Inc., 348 River Rd., N. Arlington, N.J.
Taylor Instrument Companies, 95 Ames St., Rochester 1, N.Y.
Testing Machines, Inc., 72 Jericho Turnpike, Mineola, N.Y.
United Electric Controls Co., 85 School St., Watertown 72, Mass.
United Sensor & Control Corp., 122 Naubuc Ave., Glastonbury, Conn.
West Instrument Corp., 4263 W. Montrose Ave., Chicago 41, Ill.
Weston Instruments, Div. of Daystrom, Inc., 614 Frelinghuysen Ave., Newark 12, N.J.

Marking Machines

Ackerman Gould Co., 10 Neil Court, P.O. Box 188, Oceanside, N.Y.
The Acromark Co., 5-13 Morrell St., Elizabeth 4, N.J.
Apex Machine Co., 14-13—118 Street, College Point 56, N.Y.
Defiance Machine & Tool Co., 1920 S. Vandeventer Ave., St. Louis 10, Mo.
Gane Bros. & Lane, Inc., 1335 W. Lake St., Chicago 7, Ill.
Halvorfold Kwikprint Co., 700 E. Union, Jacksonville, Fla.
Industrial Marking Equipment Co., Inc., 655 Berriman St., Brooklyn 8, N.Y.
Kingsley Machines, 850 Cahuenga Blvd., Hollywood 38, Calif.
Markem Machine Co., 150 Congress St., Keene 20, N.H.
James H. Matthews & Co., 3829 Forbes Ave., Pittsburgh 13, Pa.
Olsenmark Corp., 124-132 White St., New York 13, N.Y.
Omni Products Corp., 460 Fourth Avenue, New York 16, N.Y.
Peerless Roll Leaf Co., Inc., 4511 New York Ave., Union City, N.J.
Skyline Industries, Titusville, Pa.
Superior Roll Leaf Mfrs., Inc., 14 Porter St., Haokensack, N.J.
Swan Machine Corp., 320 Fifth Avenue, New York 1, N.Y.
Weber Hot Stamping Equipment Co., 3253 N. Kedzie Ave., Chicago 13, Ill.

Mixers & Blenders

Abbe Engineering Co., 420C Lexington Avenue, New York 17, N.Y.
Paul O. Abbe, Inc., 257 Center Avenue, Little Falls, N.J.
Blaw-Knox Co., 300 Sixth Avenue, Pittsburgh 22, Pa.
Arthur Colton Co., Div. of Snyder Corp., 3400 E. Lafayette St., Detroit 7, Mich.
D. C. Cooper Co., 1467 S. Michigan Ave., Chicago 5, Ill.
Crown Machinery, Inc., 2721 S. San Pedro St., Los Angeles 11, Calif.
Dake Corp., 641 Robbins Rd., Grand Haven, Mich.
The J. H. Day Co., Div. of Cleveland Automatic Machine Co., 4932 Beech St., Cincinnati 12, O.
J. P. Devine Mfg. Co., 49th St. & A.V.R.R., Pittsburgh 1, Pa
Entoleter Div., Safety Industries, Inc., 1187 Dixwell Ave., New Haven, Conn.
Ferro Corp., Patterson Equipment Div., E. Liverpool, Ohio
First Machinery Corp., 209-289—10th St., Brooklyn 15, New York
Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio
Johnson Machinery Co., 683 Frelinghuysen Ave., Newark 5, N.J.
Lupoline Automatic Polishing Equipment Corp., 4510 Bullard Ave., Bronx 70, N.Y.
Franklin P. Miller & Son, 36 Meadow Street, E. Orange 16, N.J.
Patterson Foundry and Machine Co., 1250 St. George St., E. Liverpool, Ohio
The Patterson-Kelley Co., Inc., E. Stroudsburg, Pa.
Prodix Corp., King George Road, Fords, N.J.
The Rainville Co., Inc., 839 Stewart Avenue, Garden City, New York
Read Standard, Div. of Capitol Products Corp., 901 S. Richland Ave., York, Pa.
Reed Plastics Corp., 116 Gold Street, Worcester 8, Mass.
Reliable Rubber & Plastics Machinery Co., Inc., 2014 Union Turnpike, No. Bergen, N.J.
Charles Ross & Son Co., 148 Classon Ave., Brooklyn 5, N. Y.
Sprout, Waldron & Co., Inc., 130 Logan Street, Muncy, Pa.
Sturtevant Mill Co., 103 Clayton Street, Boston, Mass.
Young Machinery Co., Inc., R.D. #2, Muncy, Pa.

Mold Chillers

Al-Be Industries, 9516 Rayo St., South Gate, Calif.
Anson Tools & Gages, Inc., 1504 W. 12th St., Erie, Pa.
Artisan Metal Products, Inc., 63 Pond St., Waltham 54, Mass.
Blaw-Knox Co., 300 Sixth Avenue, Pittsburgh 22, Pennsylvania
Dean Panel Coil, Dean Products, Inc., 1048 Dean St., Brooklyn 38, N.Y.
Frank W. Egan & Co., 671 S. Adamsville Rd., Somerville, N.J.
Electric Trading Co., 313-315 Canal St., New York 13, N.Y.
Gerin Mfg. Co., Inc., 683-685 N. 5th St., Newark 7, N.J.
Goulding Mfg. Co., 2929 River St., Saginaw, Mich.
Industrial Ovens, Inc., 13825 Triskett Rd., Cleveland 11, Ohio
Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio
L & P Tool Co., 2861 Sidney Avenue, Cincinnati 25, Ohio
Lembo Machine Works, Inc., 248 E. 17th St., Paterson 4, N.J.
Liberty Machine Co., Inc., 275 Fourth Ave., Paterson 4, N.J.
Mayer Refrigerating Engineers, Inc., Boonton Turnpike, Lincoln Park, N.J.
Mercury Industries, Inc., 365 Broadway, Hillsdale, N.J.
Mercury Molding Machinery, Inc., 972 Nepperhan Ave., Yonkers, N.Y.
Modern Plastic Machinery Corp., 64 Lakeview Avenue, Clifton, N.J.
Motch & Merryweather Machinery Co., 1258 E. 222nd St., Cleveland 17, Ohio
National Rubber Machinery Co., 57 W. Exchange St., Akron 8, Ohio
Omni Products Corp., 460 Fourth Avenue, New York 16, N.Y.
Pecorp, Inc., Basin Rd., P.O. Box 3164, Wilmington 4, Delaware
The Rainville Co., Inc., 839 Stewart Avenue, Garden City, New York
Saren, Inc., 816 N. Kostner Ave., Chicago 51, Ill.
T. Shriver & Co., Inc., 808 Hamilton St., Harrison, N.J.
Sterling, Inc., 5200 W. Clinton Ave., Milwaukee, Wis.
Tenney Engineering, Inc., 1090 Springfield Rd., Union, N.J.
John Verduin Machine Corp., 345-357 Tenth Ave., Paterson 4, N.J.
Vic Mfg. Co., 1313 Hawthorne Avenue, Minneapolis, Minn.
John Waldron Corp., P.O. Box 791, River Rd., New Brunswick, N.J.
Wilkinson Co., 619 E. Tallmadge Ave., Akron 10, Ohio

Mold Heating

American Hydrotherm Corp., 10-55 Jackson Ave., Long Island City 1, N.Y.
Blaw-Knox Co., 300 Sixth Avenue, Pittsburgh 22, Pa.
E. B. Blue Co., 651 Connecticut Avenue, S. Norwalk, Conn.
Briscoe Mfg. Co., 1055 Gibbard Ave., Columbus 3, Ohio
Clifton Hydraulic Press Co., 289 Alwood Rd., Clifton, N.J.
Conapac Corp., 120 E. 13th Street, New York 3, N.Y. (U.S. & Canadian Dist. for Hydro-Chemie Ltd.)
D. C. Cooper Co., 1467 S. Michigan Ave., Chicago 5, Ill.
Dean Panel Coil, Dean Products, Inc., 1048 Dean St., Brooklyn 38, N.Y.
Devco Engineering Inc., Peir Lane, W. Caldwell, N.J.
Electric Trading Co., 313-315 Canal St., New York 13, N.Y.
Erinac Equipment Corp., 225 Lafayette St., New York 12, N.Y.
Falcon Equipment Co., 13th Street, New Brighton, Pa.
General Electric Co., Apparatus Sales Div., 1 River Rd., Schenectady 5, N.Y.
Gerin Mfg. Inc., 683-685 N. 5th St., Newark 7, N.J.
Glenn Electric Heater Corp., 372 Jelliff Ave., Newark 8, N.J.
Grieve-Hendry Co., Inc., 1401 W. Carroll Ave., Chicago 7, Ill.
Guild Electronics, Inc., Dynatherm Division, 388 Broadway, New York 13, N.Y.
Hotwatt, Inc., 75 Maple St., Danvers, Mass.
Improved Machinery, Inc., 150 Burke St., Nashua, N.H.
Industrial Heater Co., Inc., 417 Canal Street, New York 13, N.Y.
Industrial Mfg. Corp., 31 E. Georgia St., Indianapolis 4, Ind.
Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio
Mercury Molding Machinery, Inc., 972 Nepperhan Avenue, Yonkers, N.Y.
Omni Products Corp., 460 Fourth Avenue, New York 16, N.Y.
Pantex Mfg. Corp., 520 Roosevelt Avenue, Pawtucket, R.I.
Powers Regulator Co., 3400 Oakton St., Skokie 34, Ill.
The Rainville Co., Inc., 839 Stewart Avenue, Garden City, New York
Robbins Plastic Machinery Corp., 1430 Mishawaka St., Elkhart, Ind.
W. S. Rockwell Co., 200 Eliot Street, Fairfield, Conn.
Sterling, Inc., 5200 West Clinton Avenue, Milwaukee 18, Wis.
Thermel, Inc., 9400 Robinson Road, Franklin Park, Ill.
John Verduin Machine Corp., 345-357 Tenth Avenue, Paterson 4, New Jersey
Watlow Electric Mfg. Co., 1376 Ferguson Avenue, St. Louis 14, Mo.
Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8, Pa.

Mold Parts, Standard

Crucible Steel Co., of America, P.O. Box 2518, Pittsburgh 30, Pa.
Damen Tool & Engineering Co., Inc., 4621-4627 N. Olcott Ave., Chicago 31, Ill.

Detroit Mold Engineering Co., 6686 E. McNichols Rd., Detroit, Mich.
National Tool & Mfg. Co., 100 N. 12th St., Kenilworth, N.J.
Omni Products Corp., 460 Fourth Avenue, New York 16, N.Y.
Van Dorn Iron Works Co., 2685 East 79th St., Cleveland 4, Ohio

Nozzles, Injection Machine

Anson Tools & Gages, Inc., 1504 W. 12th Street, Erie, Pa.
Atlas Machine & Tool Corp., 259 Hackensack St., East Rutherford, N.J.
Blaw-Knox Co., 300 Sixth Avenue, Pittsburgh 22, Pa.
Brush Beryllium Co., 4301 Perkins Ave., Cleveland 3, Ohio
Clifton Hydraulic Press Co., 289 Alwood Rd., Clifton, N.J.
Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio
Melt Extractor Mfg. Corp., 3040 Webster Ave., New York 67, New York
Omni Products Corp., 460 Fourth Avenue, New York 16, N.Y.
Rainco Mfg., Inc., R.D. #2, Franklin, Pa.
Standard Tool Co., 203 Hamilton Street, Leominster, Mass.

Ovens, Drying

Acme Machinery & Mfg. Co., Inc., 20 South Broadway, Yonkers, 2, N.Y.
American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.
Binks Mfg. Co., 3114 W. Carroll Ave., Chicago 12, Ill.
Blaw-Knox Co., 300 Sixth Avenue, Pittsburgh 22, Pa.
E. B. Blue Co., 651 Connecticut Avenue, S. Norwalk, Conn.
I. G. Brenner Co., 32 East North St., Newark, Ohio
Brosites Machine Co., Inc., 50 Church St., New York 7, N.Y.
Arthur Colton Co., Div. of Snyder Corp., 3400 E. Lafayette St., Detroit 7, Michigan
Continental Machinery Co., Inc., 261 Broadway, New York 7, N.Y.
D. C. Cooper Co., 1467 S. Michigan Avenue, Chicago 5, Ill.
F. C. Dawson Engineering Co., 641 Washington St., Canton, Mass.
The DeVilbiss Co., 300 Phillips Ave., Toledo 1, Ohio
J. P. Devine Mfg. Co., 49th St., & A.V.R.R., Pittsburgh 1, Pa.
Drying Systems Co., 1800 Foster Avenue, Chicago 40, Ill.
Ferro Corp., Patterson Equipment Div., E. Liverpool, Ohio
Fisher Scientific Co., 711 Forbes Ave., Pittsburgh 19, Pa.
Fostoria Corp., Infrared Division, Fostoria, Ohio
Grieve-Hendry Co., Inc., 1401 W. Carroll Ave., Chicago 7, Ill.
Guild Electronics, Inc., Dynatherm Div., 388 Broadway, New York 13, N.Y.
Herbert Products, Inc., 74-32 Jamaica Ave., Woodhaven 11, New York (U.S. Rep. for Imperial Chemical Industries, Ltd., Plastics Div.)
Industrial Ovens Inc., 13825 Triskett Rd., Cleveland 11, Ohio
Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio
Inta Roto Machine Co., Inc., P.O. Box 454, Richmond 3, Va.
Johnson Machinery Co., 683 Frelinghuysen Ave., Newark 5, N.Y.
Leon Machine & Engineering Co., 61 Whittaker St., Riverside, N.J.
C. A. Litzler Co., Inc., 235 Brookpark Rd., Cleveland 9, Ohio
Lydon Bros., Inc., 85 Zabriskie St., Hackensack, N.J.
Mercury Molding Machinery, Inc., 972 Nepperhan Ave., Yonkers, N.Y.
Michigan Oven Co., 415 Brainard St., Detroit 1, Mich.
Miskella Infra-Red Co., Inc., E. 73rd & Grand Ave., Cleveland 4, Ohio
Modern Plastic Machinery Corp., 64 Lakeview Avenue, Clifton, N.J.
Radiant Heat Enterprises, Inc., 630 Morris & Essex Turnpike, Short Hills, N.J.
The Rainville Co., Inc., 839 Stewart Avenue, Garden City, New York
Randall Mfg. Co., Inc., 801 Edgewater Rd., New York 59, New York
Ransohoff Co., N. 5th St. & Ford Blvd., Hamilton, Ohio
W. S. Rockwell Co., 200 Eliot St., Fairfield, Conn.
Tenney Engineering Inc., 1090 Springfield Rd., Union, N.J.
Douglas C. Whitaker Co., Box 271, Glenside, Pa.
Young Bros. Co., 1823 Columbus Rd., Cleveland 13, Ohio

Preplasticizing Units

The Bonnot Co., 722 Mulberry Ave., S. E., Canton 2, Ohio
Crown Machine & Tool Co., 2800 W. Lancaster St., Ft. Worth, Texas
Farrel-Birmingham Co., Inc., Ansonia, Conn.
Hydraulic Press Mfg. Co., Marion Rd., Mt. Gilead, Ohio
Johnson Machinery Co., 683 Frelinghuysen Avenue, Newark 5, N.J.
Melt Extractor Mfg. Corp., 3040 Webster Avenue, New York 67, N.Y.
Moslo Machinery Co., 2443 Prospect Avenue, Cleveland 15, Ohio
Omni Products Corp., 460 Fourth Avenue, New York 16, New York
The Rainville Co., Inc., 839 Stewart Avenue, Garden City, N.Y.
Watson-Stillman Press Div., Farrel-Birmingham Co., Inc., 565 Blossom Rd., Rochester 10, N.Y.

Pumps, Hydraulic

Allis-Chalmers Mfg. Co., 1163 S. 70th St., Milwaukee 1, Wis.
Baldwin-Lima-Hamilton Corp., Phil. Nat'l. Bank Bldg., Phil. 7, Pa.
Berthelsen Engineering, P.O. Box 1423, Joliet, Ill.
John Dusenbery Co., Inc., 271 Grove Ave., Verona, N.J.
Elmes Engineering Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Farrel-Birmingham Co., Inc., Ansonia, Conn.
French Oil Mill Machinery Co., 1040 W. Greene St., Piqua, Ohio
Hydraulic Press Mfg. Co., Marion Rd., Mt. Gilead, Ohio
Johnson Machinery Co., 683 Frelinghuysen Avenue, Newark 5, N.J.
Lincoln Engineering Co., 4010 Goodfellow, St. Louis 20, Mo.
Manton-Gaulin Mfg. Co., Inc., 44 Garden St., Everett 49, Mass.
The Oilgear Co., 1560 W. Pierce St., Milwaukee 4, Wis.
Racine Hydraulic & Machinery, Inc., 2000 Albert St., Racine, Wis.
Ralph B. Symons Associates, Inc., 3571 Main Rd., Riverton, R.I.
Wallace & Tiernan, Inc., 25 Main Street, Belleville 9, New Jersey

Regulators, Machine Cycle

Eagle Signal Corp., 202-20th St., Moline, Ill.
Electronic Processes Corp. of Calif., 436 Bryant, San Francisco 7, Calif.
Foster & Allen, Inc., 26 Commerce St., Chatham, N.J.
The Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
GPE Controls Inc., 240 E. Ontario St., Chicago 11, Ill.
General Electric Co., Apparatus Sales Div., 1 River Rd., Schenectady 5, N.Y.
Glenn Electric Heater Corp., 372 Jelliff Ave., Newark 8, N.J.
Partlow Corp., 225 Campion Rd., New Hartford, New York
Plastics by Chapman, 1220 S. 49th St., Richmond, Calif.
Reliance Electric & Engineering Co., 24701 Euclid Ave., Cleveland 17, Ohio
Seely Instrument Co., Inc., 377 Fourth St., Niagara Falls, New York
Taylor-Emmett Controls, Inc., 445 E. Turkeyfoot Lake Rd., Akron 19, Ohio
Taylor Instrument Companies, 95 Ames St., Rochester 1, N.Y.
Wallace & Tiernan, Inc., 25 Main St., Belleville 9, New Jersey
G. C. Wilson & Co., 1915 Eighth Ave., Huntington, W. Va.

Regulators, Pressure

Fischer & Porter Co., 30 Warminster Rd., Hatboro, Pa.
The Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
GPE Controls Inc., 240 E. Ontario St., Chicago 11, Ill.
Gabriel Mfg. Co., 15 Maple Ave., Haverstraw, N.Y.
General Electric Co., Apparatus Sales Div., 1 River Rd., Schenectady 5, New York
Helicoid Gage Div., American Chain & Cable, 929 Connecticut Ave., Bridgeport 2, Conn.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia 44, Pa.
Leslie Co., 214 Leslie Bldg., Lyndhurst, N.J.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave., S., Minneapolis 8, Minn.
Powers Regulator Co., 3400 Oakton St., Skokie 34, Ill.
Taylor Instrument Companies, 95 Ames St., Rochester 1, New York
United Electric Controls Co., 85 School St., Watertown 72, Mass.
Weston Instruments, Div. of Daystrom, Inc., 614 Frelinghuysen Ave., Newark 12, N.J.

Regulators, Temperature

Application Engineering Corp., P.O. Box 334, Park Ridge, Ill.
Barber-Colman Co., Wheelco Instruments Div., 1300 Rock St., Rockford, Ill.
Electric Auto-Lite Co., General Products Group, Champlain, Toledo 1, Ohio
Electronic Processes Corp. of Calif., 436 Bryant, San Francisco 7, Calif.
Fenwal, Inc., Pleasant Street, Ashwald, Mass.
Fischer & Porter Co., 30 Warminster Rd., Hatboro, Pa.
The Foxboro Co., 38 Neponset Ave., Foxboro, Mass.
General Electric Co., Apparatus Sales Div., 1 River Rd., Schenectady 5, N.Y.
Glenn Electric Heater Corp., 372 Jelliff Ave., Newark 8, N.J.
Industrial Mfg. Corp., 31 E. Georgia St., Indianapolis 4, Ind.
Jones Motrola Corp., 432 Fairfield Ave., Stamford, Conn.
Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia 44, Pa.
Leslie Co., 214 Leslie Bldg. Lyndhurst, N.J.
Mayer Refrigerating Engineers, Boonton Turnpike, Lincoln Park, N.J.
Minneapolis-Honeywell Regulator Co., 2753 Fourth Ave., S., Minneapolis 8, Minn.
The Partlow Corp., 225 Campion Rd., New Hartford, N.Y.
Powers Regulator Co., 3400 Oakton St., Skokie 34, Ill.
Pyrometer Instrument Co., Inc., 92 Portland St., Bergenfield, N.J.
Reliance Electric & Engineering Co., 24701 Euclid Ave., Cleveland 17, Ohio
Sarco Co., Inc., 635 Madison Avenue, New York 22, New York
Sterling, Inc., 5200 W. Clinton Avenue, Milwaukee 18, Wis.
Taylor Instrument Companies, 95 Ames Street, Rochester 1, New York
Thermo Electric Co., Inc., 109 Fifth Street, Saddle Brook, New Jersey
Thwing-Albert Instrument Co., 5398 Pulaski Ave., Philadelphia 44, Pa.
United Electric Controls Co., 85 School Street, Watertown 72, Mass.
West Instrument Corp., 4263 W. Montrose Ave., Chicago 41, Ill.
Weston Instruments, Div. of Daystrom, Inc., 614 Frelinghuysen Ave., Newark 12, N.J.

Tumbling Barrels

Abbe Engineering Co., 420C Lexington Avenue, New York 17, New York
Acme Machinery & Mfg. Co., Inc., 20 South Broadway, Yonkers 2, New York
Continental Machinery Co., Inc., 261 Broadway, New York 7, New York
Crown Machinery, Inc., 2721 S. San Pedro St., Los Angeles 11, Calif.
Ferry Machine Co., W. Main St. Extension, Kent, Ohio
Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio
H. W. Kramer Co., Inc., 120-30 Jamaica Avenue, Richmond Hill 18, N.Y.

Lord Chemical Corp., 2068 S. Queen St, York, Pa.
Lupoline Automatic Polishing Equipment Corp., 4510 Bullard Ave., Bronx 70, N.Y.
Morse Mfg. Co., Inc., 727 W. Manlius St., East Syracuse, N.Y.
Omni Products Corp., 460 Fourth Avenue, New York 16 New York
Rampe Mfg. Co., 14915 Woodworth Ave., Cleveland 10, Ohio
Ransohoff Co., North 5th St. & Ford Blvd., Hamilton, Ohio
The R. R. Siebert Co., 183 St. Paul St., Rochester, New York
Techline Div., Wheelabrator Corp., 1414 Avenue V, Vicksburg, Mich.
Tower Iron Works, Inc., 50 Borden St., Providence, R.I.
Tumb-L-Matic, Inc., St. Mary's Street, Stamford, Conn.

Weigh-Feeders

Exact Weight Scale Co., 919 W. 5th Avenue, Columbus 15, Ohio
Glengarry Processes, Inc., Bay Shore, New York
B. F. Gump Co., 1325 S. Cicero Ave., Chicago 50, Ill.
Mercury Heat Sealing Equipment Co., 2601-21 N. Howard St., Philadelphia 33, Pa.
Plastic Fabricants, Div. of The Woodman Co., Inc., 647 E. College Ave., Decatur, Ga.
Proctor & Schwartz, Inc., 7th St., & Tabor Rd., Philadelphia 20, Pa.
The Rainville Co., Inc., 839 Stewart Avenue, Garden City, New York
Richardson Scale Co., 688 Van Houten Ave., Clifton, New Jersey
Syntron Co., P.O. Box 2200, Homer City Pa.
Toledo Scale, Div. of Toledo Scale Corp., 1087 Telegraph Rd., Toledo 12, Ohio
Wallace & Tiernan, Inc., 25 Main Street, Belleville 9, New Jersey
Weighing & Control Components, Inc., 206 Lincoln Avenue, Hatboro, Pa.

Guest editorial

Instrumentation as seen at the Dusseldorf plastics exhibition

by HERBERT PROSKE

N. Y. District Manager,
Wheelco Instruments Co. Div.,
Barber-Colman Co., Rockford, Ill.

The Plastics Fair at Dusseldorf, held once every four years, gives an observer from the United States a wonderful opportunity to appraise trends, designs, and marketing methods on a broad scope. In comparison to the "Plastic Shows" of this country, the 1959 Dusseldorf exhibit was four or five times larger. Six giant halls, two of them multi-storied, housed 624 exhibitors and attracted an attendance estimated at over a million people.

From the standpoint of instrumentation, the international scope of the affair attracted exhibitors from England, France, Italy, Germany, and the United States, although German-made instruments by far dominated the show. Among the many varied exhibitors of equipment and raw materials, there were approximately 50 machinery manufacturers of temperature-controlled units. The largest percentage making use of instrumentation were injection machines. These were followed by extrusion, blow molding, and vacuum forming machines.

It was my observation that the number of instruments per machine was much gerater than those which normally are supplied per machine in our domestic market. In short, more instruments, but fewer heaters per zone are used than what we consider as "standard" practice. The chief engineer of one of the larger English extruder manufacturers, who had on display a machine with 10 instruments, stated that he would like to make use of still more instrumentation.

While many of the instruments shown were not as "sophisticated" as ours, the manufacturers seemed to achieve satisfactory control results. However, I couldn't help but gain the impression that many of the original equipment manufacturers do not consider the need of flexibility in instrumentation that is required by the ever-changing materials picture.

In discussing the use of instruments as manufactured in this country, I found a great deal of enthusiastic interest expressed in our use of pressure transducers, molten stock-temperature thermocouples, and the many advantages which can be achieved by the use of stepless-type controllers either with and without automatic reset. Even though substantial interest was shown in instrumentation as produced in the United States, it seemed to be the consensus of opinion that Germans would prefer to buy German equipment even at the cost of what was termed "a little quality". In general, machine manufacturers' main interest is in instruments which are designed to meet the DIN-H NORMS (German standards) which are the standards for installations other than those requiring special instrument design features.

The thermoplastic machine people exhibiting at Dusseldorf looked for an increase of at least 25% in European business during 1960. Many innovations in design features were apparent. One of the biggest attractions was a combination extruder and plunger which seemed to be used by an overwhelming majority of machine builders in the injection field. This preference would lead one to believe that the German machine builders, in general, tend to avoid the preplasticizer. This is quite natural, in view of the fact that by this method they did not have to use the dry-color system and, at the same time, they achieve a greater homogeneity of the raw material.

In retrospect, it seems that two over-all conclusions could be drawn, as follows:

(1). The machine manufacturers who exhibited at the Dusseldorf Plastic Show are interested, in general, only in those instruments which are designed to meet the DIN-H NORMS and those which would be competitively priced with the instruments of German manufacture.

(2). While there was substantial interest in instrumentation as manufactured in the United States, this interest was for those items which could be used in solving difficult control problems. However, enthusiasm for the purchase of this type of equipment is dampened because of the price differential.

PLASTICS TECHNOLOGY

EXPLORING FABRICATION TECHNIQUES

By L. J. ZUKOR, *Engineering Editor*

Improved fastening devices . . .

. . . for plastic parts are receiving more attention of late. I refer to those inserts which are designed to be installed after the molding process is completed. Holding power of a force-fit insert is identical to that of a molded-in type and has the added advantage of an assembly free from bothersome flash.

Threaded inserts for molding are familiar to all compression and transfer molders; injection molders; cold molding, laminating, and cold-casting operators. Here, the inserts are manually loaded into molds which have been machined specifically to accommodate them. Such molds are considerably more expensive than similar molds made without provision for inserts. Furthermore, secondary operations are generally required—hand loading of the mold, manual flash removal, and buffing of inserts after molding to remove traces of oxidation and tarnish.

With push-fit inserts, the finished molding or casting can be tumbled for flash removal after which the inserts are pressed into the plastic by means of an arbor or kick press equipped with a holding fixture or jig. When production warrants, an insert feed device attached to the automatic-type arbor press can be used. Holes for push-fit inserts can be drilled or molded into the plastic part.

Push-fit inserts are also well suited for use in rigid extrusions, wood or glass cloth-polyester type laminates, and heavy walled blow-molded objects. The three types of plastic work outlined above cannot accommodate a molded-in type insert.

Molders who contemplate using press-fit inserts should be aware that they are not cure-alls but are useful in situations where molded-in inserts would have a tendency to loosen in the socket, even when deeply knurled. They are also useful in "Precision Molding" operations, when molded-in inserts cannot be anchored properly in the mold. Weakly-supported inserts are easily displaced by the viscous flow of plastic. In this operation, a displacement as low as 0.005-inch is often enough to cause rejects. However, in rigid plastic (very low creep) materials, where stresses caused by an interference fit (pressing a part into a slightly smaller hole) could eventually cause crazing or cracking, the assembly should be stress relieved by annealing with controlled radiant or dielectric heat. When this is not feasible, then press-fit inserts should be avoided.

Inserts like other hardware units are manufactured in various shapes and types. Some are internally threaded; other externally threaded; still others are electrical and tubular feed-throughs, either with or without threads.

Many plastics end-users stress proper fastening when selecting a custom molder for their product. It might be well for the molders to examine thoroughly all types of fasteners and adapt the one which best suits their needs.

Some applications of force-fit inserts used by fabricators are well worth mentioning. One which I have seen, is an ingenious sun-glass frame hinge. A specially designed, automatic machine is used, the feed hopper of which supplies inserts to the air cylinder plunger.

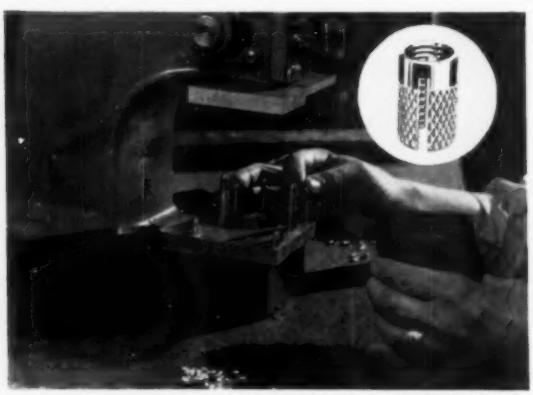
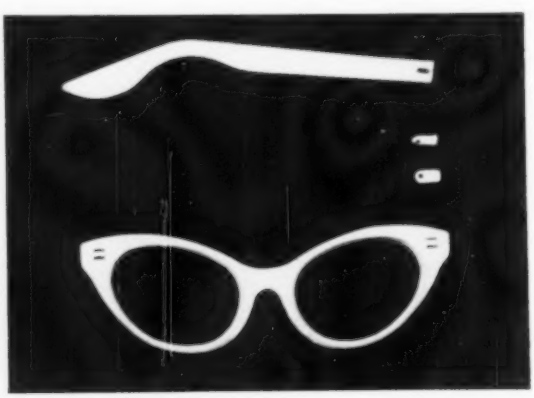


Photo courtesy: Boots Mfg. Co.

Assembly of inserts in meter case.



Sun glass frame hinge.

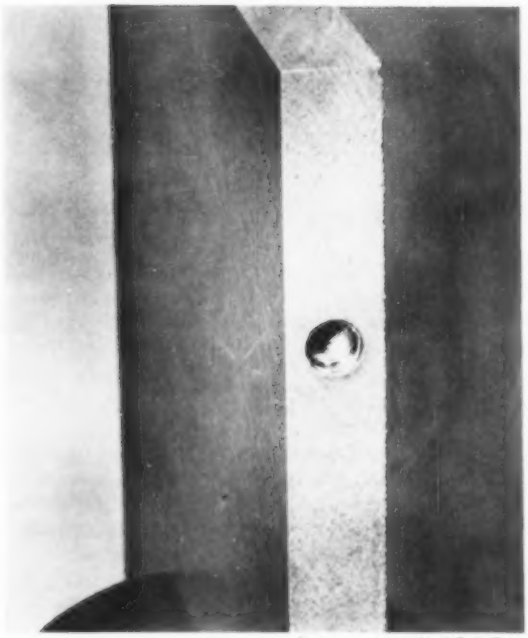


Photo courtesy: Heli-Coil Corp.

Insert assembly in reinforced plastic.

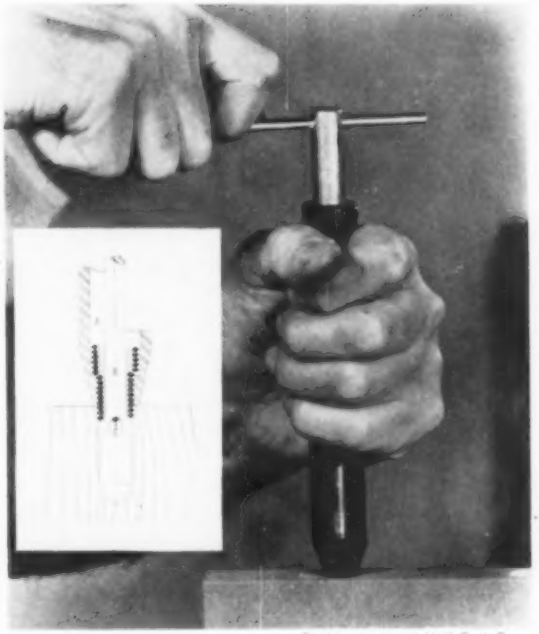


Photo courtesy: Heli-Coil Corp.

Prewinder engaging insert tang during assembly.

The flow of the plastic parts into the machine trips a micro-switch, initiating the cycle. The holes receiving inserts are formed in the injection molding operation. This method of assembly is faster, cleaner, and more reliable than either the molded-in insert or riveted type hinge. Production rates exceed 12,000 units per day. The reader should note, that although this operation is successful with nylon, other stiffer materials might crack or break open.

International Instruments Co., New Haven, Conn., is using Boots-type push-fit inserts in its meter case. Type MFE mineral-filled phenolic is used for the case body. Inserts are installed in one shot by a hand-operated arbor press. As seen in the photo, this is a manual operation and is best suited to short-run production.

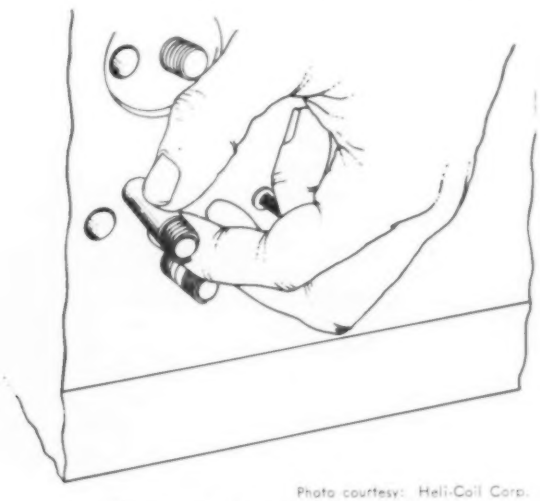


Photo courtesy: Heli-Coil Corp.

Inserts on pins being placed in mold.

Heli-Coil wire thread inserts are being used by The Glastic Corp., Cleveland, Ohio, in its 3,000 ampere mine safety switch. The inserts are used to attach covers to a fiberglass mat-reinforced polyester box. This company ran many tests aimed at evaluating thread failure of the insert versus an unprotected, tapped hole. The results of their tests supported by service experience established that inserts in polyester laminates produced stronger, wear resisting threads. Material specified for the inserts was stainless steel, which had the added advantage of corrosion resistance and excellent appearance. Another company, Yan-Nell Industries, Newark, N. J., uses another version of the wire thread inserts. These are molded-in inserts and differ from those previously mentioned by having a slightly heavier wire section without spring back, the radial holding force being transmitted to the plastic material. This type of insert is used in the cover assembly of the Yan-Nell jet carbonator, an injection molded butyrate part. The molding inserts are placed on thread-loading studs and placed into the mold. After the molding cycle is completed and the part ejected, the loading studs are removed from the piece leaving stainless steel threads behind. Because the coils are flexible, stresses that usually concentrate around a solid insert are avoided.

Ample consideration should be given to radial stress built into holes by inserts, since this can have added to it any shear stress and bending carried by the screw. When the amount of material in the thread boss will not support the combined stress, tensile failure of the plastic will occur. Boss diameters in plastics should be calculated for maximum stress multiplied by a nominal safety factor as in any other type of engineering material.

Reinforced plastics

New Horizons for Additional Reinforced Plastics Uses

Edited by:

HARRY T. DOUGLAS

When civilized men first saw the dome-shaped igloos of the Eskimos built out of individually-shaped blocks of snow and ice, the former being superior in intellect, education, and advantages, undoubtedly were amused at the crude structure of these native dwellings. Today, reinforced plastics geodesic domes, which resemble large igloo-like structures, dot the Arctic areas.

These enormous domes, some as high as 55 feet, are designed to withstand high-velocity winds and extremes of temperature. Having proved themselves as structures which can be disassembled, stacked, shipped, and reassembled easily, the light weight, durable, weather-resistant domes suggest many uses apart from their military significance.

Recently, attention has been focused on the vast unexplored areas of the Antarctic during the Geophysical year. The vital discoveries made during that year have inspired an indefinite continuance of the program. Because of the tremendous land areas in the Antarctic and natural climactic conditions, this part of the world lends itself to the problem of storing vast food supplies without the present staggering expense of refrigeration in Government storehouses. It costs the taxpayers $1,000 a minute to pay for Government storage of just one surplus food commodity in the United States.

Helicopters were used to transport some of the geodesic structures in the Arctic as a ship-to-shore conveyance. The light weight of the molded reinforced plastic parts made such trips possible. In the Antarctic, construction of dwellings for scientific groups and storehouses for their equipment is accomplished during the summer season when the sun shines for a six-month period, and helicopters are employed for a large part of the engineering work in transporting heavy pieces of equipment. Interestingly enough, reports have come back mentioning that food was found in an excellent state of preservation even though left there more than 30 years ago by previous explorers. Also, interesting speculations have been made about a section of the South Pole that had a warmish land area which contained little or no snow.

In any event, with the alarming world population exploding to double its enormous proportions, more food will be needed to feed these future generations. It would seem logical to store the world surplus foods in nature's refrigerators; the North and South Poles. It also would appear logical to explore the mineral-rich farm areas underneath the snow.

This is not as farfetched as it may seem to some. Robert L. Zahour, manager of application engineering for the Westinghouse Electric Corp.'s lamp division, recently stated that future farms may even go underground where temperature, weather conditions, plant diseases, nutrition, and lighting can be controlled accurately. Also, several years ago, a long-term project was begun with the cooperation of Rutgers University. A greenhouse, from which all daylight was excluded, was used solely with lamp light and grew several different plants. Mr. Zahour pointed out that light intensities were about one-hundredth of noon-day sunlight, which is similar to that found in home reading lamps.

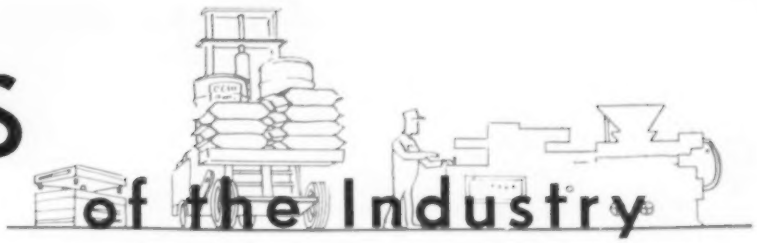
The many uses of reinforced plastic products can be foreseen easily in future projects of this kind. Reinforced-plastic geodesic structures for greenhouses and food storage warehouses; fiberglass pipes and tanks for irrigation and water storage; garden implements made from reinforced plastics to withstand corrosion and severe weathering in these wet, cold parts of the world; and non-corrosive chemical tanks.

Along these lines of thought, we might want to include the progressive step taken by the Interior Department which has lifted such projects out of the science-fiction realm to a more practical and believable plateau. This government agency has approved an order permitting oil and gas leasing and the staking of mining claims on about 20,000,000 acres in Alaska above the Arctic Circle.

It may be of interest to readers to know that many of the so-called "predictions" for reinforced plastics made in this column for the past few years have materialized not because the author is a "prophet," but is only a disciple of the limitless uses of reinforced-plastic materials. One of the subjects discussed here concerned space stations which could be made from reinforced plastics, brought many pro and con letters from believers and doubters. The reinforced-plastics station story appeared about two years ago in this publication and at February's 15th Annual Conference of the SPI Reinforced Plastics Division in Chicago, D. V. Rosato and J. J. Mobilia, Raytheon Company researchers, reported that plans for saucer-like platforms are now in operation. Therefore, it may not be too farfetched to expect bananas grown in Alaska under reinforced-plastic greenhouses, or oranges from Antarctica.

Executive Vice President, Lunn Laminates, Inc., Huntington Station, New York

NEWS of the Industry



national packaging exposition

The 29th AMA National Packaging Conference and Exposition was held April 4-6 at Atlantic City's Convention Hall. Space does not permit a proper description of all the products and exhibits, but some of the highlights included Union Carbide's films, extrusion coatings, and molded and thermoformed packaging; Hartig Extruders' demonstration of resin to printed bag in one integrated operation using its 2½-inch extruder and a Roto Pacemaker bag maker and printing machine; in-line automatic blister packaging using a Packaging Industries machine and Celanese acetate sheet; Modern Plastic Machinery Corp.'s Diversamatic Twin-Station Blow Molding set-up; Sheffield Plastics' expanded styrene containers; USI's scented polyethylene film; Eastman's modified curtain coater to coat polyethylene on paper; Allied Chemical's quick-breaking aerosol foam, FDA colors and dyes, and a polyester foam process; Goodyear flexible packaging materials; Enjay's Escon polypropylene; Schjeldahl's Split-Roll polyethylene bag maker, polystyrene sealer, and continuous motion perforator; Spencer's "Polymorphous" Polyethylene; Emhart's S-K Tape Line automatic case taping unit; and the Jackmeyer Stik-On Blister Pac.

business developments

Foster Grant Co. plans to enter the polyolefin field and will build a multi-million dollar plant utilizing the high-pressure polymerization technique. The first material to be produced will have a broad density range and melt index.

Magnolia Plastics, Inc., Chamblee, Ga., has introduced two product lines—epoxy tubing and epoxy pellets (preforms). A complete range of flexibility, cure cycles, and sizes are available, also custom formulation to individual requirements.

Rexall Drug & Chemical Co. and **El Paso Natural Gas Co.** have joined forces to produce and market petrochemicals. Plants will be built in Odessa, Tex., to produce ethylene, propylene, both polyethylene types, and polypropylene.

Phillips Chemical Co. plans to market 14 medium and low density polyethylenes. Also to be called Marlexes, the resins will be made from ethylene produced by Phillips and converted by USI at its plant in Houston, Tex.

Taylor Fibre Co. has initiated a study of missile applications involving plastic laminates. Up till now, the laminates were developed for electrical applications, and their suitability for missiles was more or less accidental. Among the grades under investigation are nylon-web, phenolic, and glass-epoxy.

Pennsalt Chemicals Corp. has developed a fluorine-containing thermoplastic resin called RC-2525, which is suitable for all methods of fabrication. Chemically, the material is a polyvinylidene fluoride with high resistance to heat, light, and chemicals.

The Department of Defense is preparing to establish a technical evaluation center for plastic and reinforced plastic materials. It will be set up at Picatinny Arsenal, Dover, N. J., and will have the following functions: collect, evaluate, and disseminate technical information; provide technical assistance to military contractors and suppliers; prepare and issue reports on technological aspects of plastics engineering; and stimulate advances in standardization.

Toyad Corp., Latrobe, Pa., has increased its facilities for producing expanded polystyrene beads.

Thiokol Chemical Corp. has developed a new solid propellant rocket binder designated C-12. The formula is said to contain more hydrocarbon than present hydrocarbon formulations. Hydrocarbon improves specific impulse, which is essentially responsible for the efficiency of the binder.

SPI's vinyl-metal laminators institute reports 12-million square feet of production in 1959, a 14% increase over the previous year.

new plants, labs & additions

Colton Chemical Co., a division of Air Reduction Co., plans to build a resin plant at City of Industry, Los Angeles County. Supporting facilities will include a sales office, technical service laboratory, and a warehouse for Flexbond and Vinac resins.

Sealomatic Electronics Corp., Brooklyn, N. Y., has acquired larger quarters at Scott Ave. and Randolph St.

Food Machinery & Chemical Corp. is enlarging its chemical research & development center at Princeton, N. J.

Sinclair Oil Corp. and **Koppers Co.** jointly announced plans to erect a petrochemical plant at Houston, Tex. The unit will turn out styrene monomer and should be in operation by mid-1961. Sinclair will supply the raw material, separating ethylbenzene from an aromatic stream and dehydrogenating it to produce styrene monomer. Koppers will use and/or market the estimated 70-million pound annual production.

The Rainville Co., Inc., has moved to new quarters at 839 Stewart Ave., Garden City, N. Y. Adjoining the new offices, the firm has set up a 1,500 square foot demonstration bay.

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PLASTICS

Names in the News

Dr. William B. Reynolds has been named vice president of General Mills, Inc., Minneapolis, Minn., and director of research. Previously he had been director of research for Phillips Petroleum Co., where he served since 1946. After receiving his degrees, he served with DuPont and Interchemical Corp.

Richard D. Payton has been appointed sales manager of Warminster Fiberglass Co. He was formerly a sales engineer for the glass products division of Fischer & Porter Co., and before that was with Har-Lee Rod, Inc.

Charles H. Frantz

Charles H. Frantz has been named director of engineering for Lenox Plastics, Inc. In this newly-created position, Mr. Frantz, who has worked for the past five years with Chicago Molded Products, will assume responsibility for product research and development and production engineering for the firm's St. Louis and Puerto Rico plants.

Ralph M. Plumley has been appointed product engineer for Beetle Plastics, Crompton & Knowles. Before assuming this job, in which he will be responsible for design and development of corrosion resistant equipment, he was chief engineer for Pla-Tank division of Haveg Industries.

George Matacek has been promoted to the position of chief chemist at the recently-established western division of Bee Chemical Co. in Gardena, Calif. He formerly served as a group leader in the company's Chicago research department.

Walter M. Boyse has been named director of traffic for Carlon Products Corp. In this recently created position, Boyce will be responsible for traffic activities for all of Carlon's multi-plant operations. He was formerly associated with Glidden Co.

John J. Denbrock has been promoted to the position of assistant to the vice president in charge of plastics for The General Tire & Rubber Co., Akron, O. He will work closely with General's Bolta, Textileather, and Jeannette plastics operations on all sales, advertising, and merchandising. Formerly associated with the company's building materials division, he has been with General Tire for 15 years.

George A. Hudson, a chemist with Mobay Chemical Co., has received the firm's annual Research Award for 1959 in recognition of his "outstanding contributions to the development of urethane coatings systems and polymer modifications." Since he joined Mobay as a research chemist in 1955, Mr. Hudson has studied the application of isocyanate chemicals to various types of coatings, ranging from extremely hard films for metals and concrete to soft but abrasion-resistant coatings for leather, rubber, and flexible materials.

Willard deCamp Crater, Jr., has been appointed Executive Vice President and General Manager of American Molding Powder & Chemical Co., Brooklyn, N. Y. He came from W. R. Grace & Co., where he had been Marketing Director of the Polymer Chemicals Division. In his new affiliation, he will be expanding domestic and export activities for American Molding, particularly in color masterbatches used in the pigmentation of polyethylene and vinyl film made by extrusion and calendering, and in the pigmentation of plastic monofilaments made of polyethylene and polypropylene.

M. M. Gruber and **Elliott N. Dorman** have been named Sales Manager and Technical Sales Manager, respectively, for CIBA Products Corp., Fair Lawn, N. J. Mr. Gruber formerly was Head of Coatings Resins Sales for the company, while Mr. Dorman previously had been Head of Structural Resins Sales. **Richard H. Malamphy** joined the company as Manager for New Products, after having served with Naugatuck Chemical Division, U. S. Rubber Co.

R. M. Leiter

K. W. Kithil

K. W. Kithil, R. M. Leiter, and **R. J. Werner** have been named to three new positions on the sales staff of Celanese Corp. of America. Mr. Kithil, as field sales manager, will supervise direct sales efforts of the company's field force. For the last seven years, he has managed sales in the Cleveland district. Sales manager for molding compounds and resins, Mr. Leiter was most recently director of sales, molding compound department. Mr. Werner, former assistant general sales manager of Celanese Chemical Co., was moved up to sales manager for film and packaging. He most recently was a district sales manager.

Robert L. Davidson

Robert L. Davidson has been elected president of Kurz-Kasch, Inc. Mr. Davidson, who has been with the company since 1946, was vice president and sales manager until his promotion. Retiring president, **W. G. Davidson,** will continue as treasurer of the corporation.

Harold E. Fife has joined Lincoln Plastics Corp., Stamford, Conn., as manager of Plastics Corp. of America, a subsidiary, that is used by Lincoln for the manufacture of plastic wall tile. It will also offer general-purpose crystal polystyrene for sale to the injection molding industry. Fife formerly was plant manager of the Thermoplastic Division, American Cyanamid Co., plant at Wallingford, Conn.

L. P. Thies has been appointed manager of Chemical Division, The Goodyear Tire & Rubber Co.'s new sales department, Polyester Products. He formerly headed the Division's Detroit, Mich., sales office. In his new post, he will be responsible for sales and technical sales service of the company's polyester resin, Vitel, to the fiber and textile industries.

Edwin E. Kasha has been named Head of the Color Development Laboratories for Foster Grant Co., Inc., Leominster, Mass. He formerly was Chief Colorist for Koppers Co.

Edward C. Betts and **William R. Sterr** have been named head of the Acrylic Resin Section and head of the Powder Resin Section, respectively, of the Fords Resin Production Department for Catalin Corp. of America, New York, N. Y.

OBITUARY

Robert M. McGee, technical service representative for Plaskon molding compounds at the Toledo, O., plant of Plastics and Coal Chemicals division, Allied Chemical Corp., died on March 9 after an extended illness. Mr. McGee, 57, had been associated with Plaskon since 1932, and had been sales representative for the Connecticut-New England district before his assignment to Toledo in August, 1959.

A native of Jackson, Mich., Mr. McGee was a charter member of the SPI and SPE.

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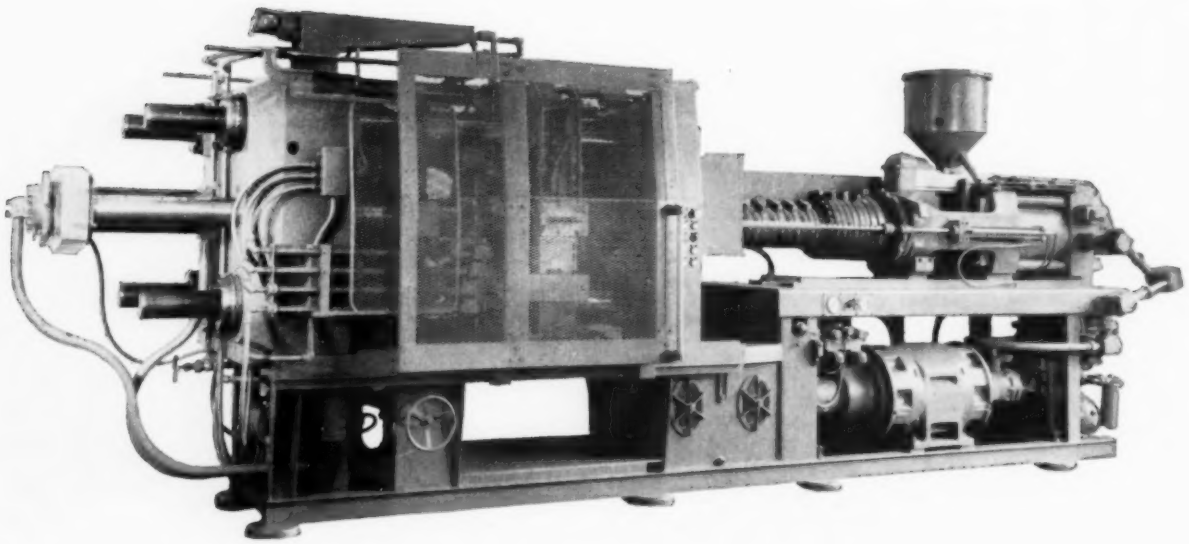

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New Materials

For more information check Readers' Service Card (p. 103)

Flexible Epoxy Casting Systems

Hysol 6622-105, a flexible, filled epoxy resin system characterized by excellent thermal and mechanical shock resistance, has been announced by Houghton Laboratories, Inc. Especially designed for embedding electric motor stators and transformers, it is also suitable for casting or potting large masses where exotherms cannot be tolerated. It is recommended for potting circuits and transformers with strain sensitive elements. Castings containing large steel inserts of various configurations have been cycled between —65° C and +150° C. without cracking.

Pot life at room temperature is several days; at 90° C., 1½ hours. Curing takes 16 hours at 100° C., or four hours at 125° C.

Specific gravity	1.64
Viscosity, cps., 80° C.	1,200
40 min	1,350
60 min	1,500
90 min	2,100
Gel time, minutes, 100° C.	100
125° C.	30
Shrinkage, %, max.	1.5
Hardness, Shore D	80
Elongation, %, room temperature	30
Tensile strength, psi, room temperature	3,500
Volume resistivity, ohm-cm, 105° C.	4.03×10^{10}
Dielectric constant, 105° C., 100 cps.	6.24
10 Kc.	5.64
Dissipation factor, 105° C., 100 cps.	0.1424
10 Kc.	0.405
Weight loss, 500 hrs., 130° C., %	0
1000 hrs, 130° C., %	0.34

Readers' Service Item 1

Pastel Acrylic Sheeting

Cast Optics Corp. has introduced a line of pastels to supplement its Evr-Kleer cast acrylic sheets. Since the sheeting was developed primarily for outdoor sign use, all colors are guaranteed for weather resistance and color stability.

Physical properties of pastel acrylic are the same as those of Evr-Kleer. Sheets are available in eight stock sizes and in standard thicknesses from 0.020 to 0.500 inches. Special sizes and thicknesses can be ordered.

Readers' Service Item 2

Vinyl Book Binding Adhesives

Borden Chemical Co. has announced a series of plasticized vinyl book binding adhesives for use in casing-in operations. Each of the three adhesives is a white, non-inflammable, vinyl emulsion with a mild odor. While no dilution is recommended for hand or machine (Smith Casing-In) application, the materials can be thinned with water. Each weighs nine pounds per gallon, has a pH of 4.0-5.0, and a storage life of three months.

Other characteristics of these Cascorez materials:

	CV-500-143 B	CV-509-85 B	CV-509-6 H
Viscosity, cps., 80° F.	28,000-35,000	32,000-40,000	24,000-30,000
Solids, %, ±2%	37	32	34
Properties of bond			
Dry strength	good	good	good
Water resistance	fair	good	fair
Flexibility	good	good	good

Readers' Service Item 3

Heat-Resistant Acrylic Copolymer

Recently, J. T. Baker Chemical Co. introduced a copolymer of alphamethylstyrene and methyl methacrylate called PL-11. Possessing excellent outdoor weatherability and somewhat better heat resistance (248° F. as opposed to 190-203° F.) than standard styrene-methyl methacrylate copolymers, the material is processible by virtually all thermoplastic processing techniques. Now, Baker has come up with yet another polymer which is characterized by a higher heat resistance plus higher stiffness and toughness. As yet not clear in color (straw), PL-12 is available in pilot plant quantities.

PL-12 has outstanding resistance to hot detergent solutions, and is resistant to dilute solutions of most acids, alkalis, to petroleum oils, aliphatic hydrocarbons, and alcohols. It is not resistant, however, to oxidizing acids, ketones, esters, aromatic and halogenated hydrocarbons.

Basic physical properties, as determined by ASTM methods, are reported as follows:

Heat distortion point, °F., at 264 psi.	237-244
At 66 psi.	255-262
Impact strength, ½x½ in. specimen, ft.lbs./in.	1
Tensile strength, psi.	8,000
Elongation, %	4-5
Flexural strength, psi., at 77° F.	14,000
At 160° F.	6,700
At 200° F.	2,000
At 220° F.	4,600
Flexural modulus, psi., at 77° F.	415,000
At 160° F.	265,000
At 200° F.	225,000
At 220° F.	200,000
Light transmission at 500 millimicrons, 1/10-in thickness %	75-80
Specific gravity	1.14
Hardness, Rockwell M.	78-80
Mold shrinkage, in./in.	0.003-0.007
Flammability, ½x½x5 in. specimen, in./min.	0.8
Water absorption, 24 hrs. boiling water, %	1.5
At 77° F.	0.4
Dielectric strength, short time, ⅛ in. specimen, V/mil.	>400
Dielectric constant, 50 cps.	3.1
At 10^3 cps.	2.91
At 10^5 cps.	2.74
Dissipation factor at 50 cps.	0.0354
At 10^3 cps.	0.0275
At 10^5 cps.	0.0173
Light stability	Very good
Machinability	Very good

Readers' Service Item 4

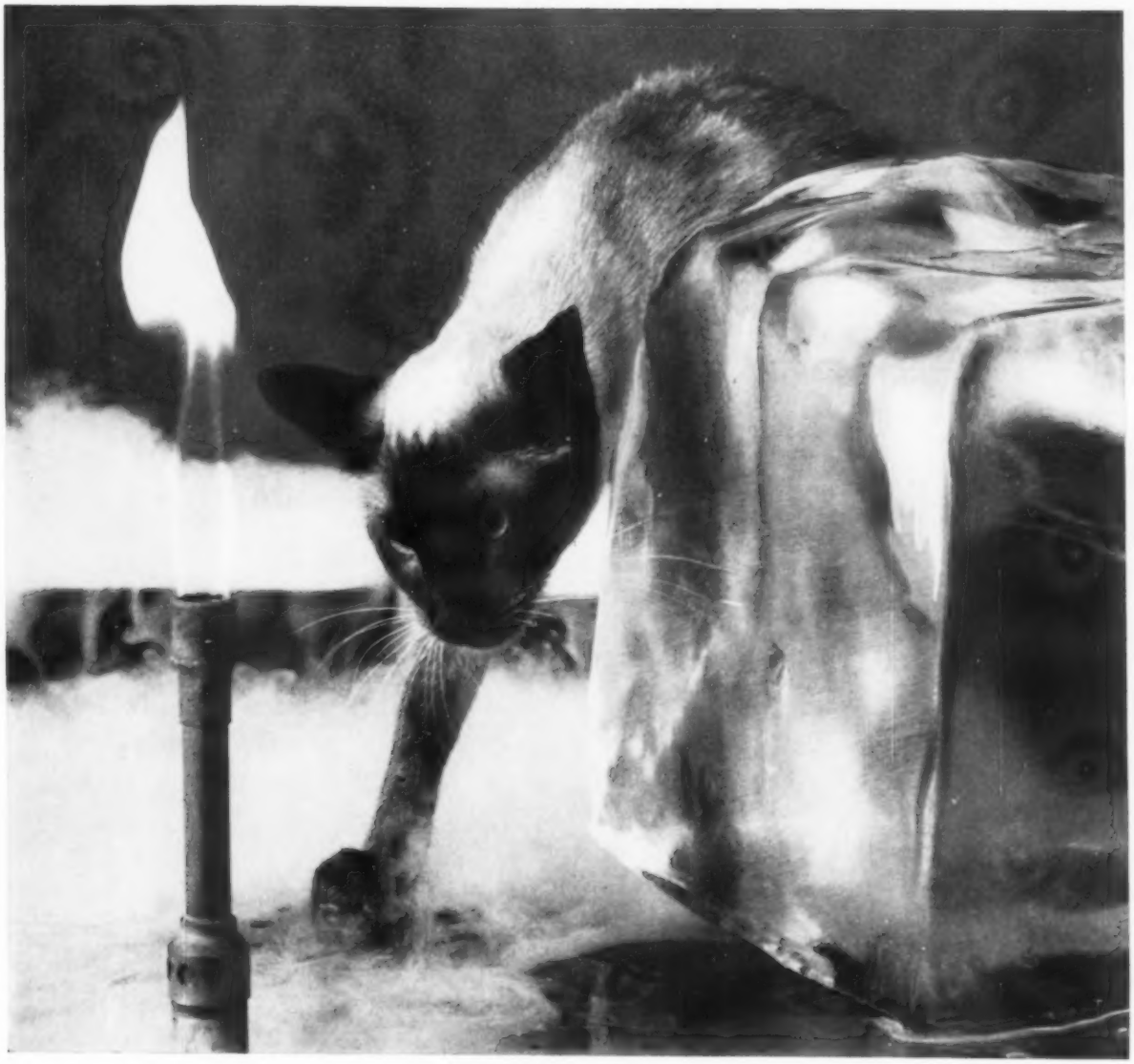
One-Part Epoxy Adhesive

Meta-Bond 321, a new 100% epoxy adhesive that requires no mixing, weighing, or metering, has been announced by Metachem Resins Corp. The material is a truly thixotropic paste which can be applied easily, even to vertical surfaces, without any running or sagging. The adhesive requires short heat-curing to form a strong bond that is stable at 200° C., and even higher in certain instances. Being 100% epoxy in type, it has excellent adhesion to metals, ceramics, glass, cement, and other temperature-stable materials, and is outstanding in chemical resistance to most fluids. Electrically, the adhesive is an excellent insulator of high dielectric strength and low loss factor.

The uncured compound is a brown paste having a specific gravity of 1.21, and a viscosity at 25° C. of 1,800-1,900 poises. The cured adhesive has a specific gravity of 1.12; a volume resistivity of 3×10^{12} ohm-cm.; a dielectric strength of 400 volts/mil for a 20-mil film; a dielectric constant of 3.8×10^3 cycles at 25° C.; and a dissipation factor at 25° C. of 0.02×10^3 cycles. The adhesive bond strength for aluminum-to-aluminum ranges from 3,200 psi. at 25° C. down to 1,300 psi. at 150° C.

Meta-Bond 321 has a shelf life of over one year if kept below room temperature. The surface to be bonded must be thoroughly clean. For very high tensile strength, it may be necessary to clean the bonding surfaces chemically. The adhesive can be applied by spreading with a spatula, and contact pressure is suitable in most applications.

Readers' Service Item 5



ARGUS TAMES THE ELEMENTS

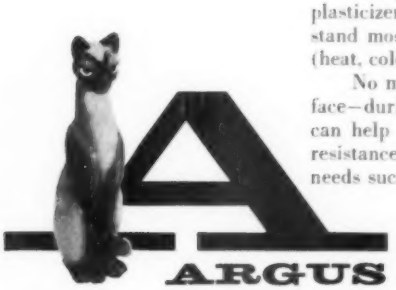
Now your vinyls can do what you'd like them to do—and enjoy long life.

The proper Mark stabilizers and Drapex plasticizers condition your products to withstand most of the potential dangers to vinyls (heat, cold, sulphide gases, sunlight, etc.).

No matter what requirements your vinyls face—during processing or in final use—Argus can help you "build in" the needed stability, resistance, flexibility and hand to meet those needs successfully.

There is a wide range of Argus products to choose from—and when you have new problems to work out, *Argus gets the answers.* Our research chemists are ever on the alert to provide you with better and better stabilizers and plasticizers at less and less cost. Argus' high standards of quality assure a longer life-span for your products... more satisfied, repeat customers for you.

Don't hesitate. Call or write for consultation, technical bulletins, samples.



ARGUS CHEMICAL CORPORATION / New York and Cleveland

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Rep's.: H. M. Royal, Inc., 11911 Woodruff Ave., Downey, California; Philipp Bros. Chemicals, Inc., 10 High St., Boston; H. L. Blachford, Ltd., 977 Aqueduct St., Montreal. European Affiliates: SA Argus Chemical NV; 33, Rue d'Anderlecht, Drogenbos, Belgium—Lankro Chemicals, Ltd.; Salters Lane, Eccles, Manchester, England.

Polyester Glazing Material

Polyglaze, a fiberglass mat reinforced-polyester, reportedly can be installed in windows just like glass. According to the manufacturer, American Polyglas Corp., Polyglaze will not break or craze, and at the same time, is competitive with glass in price. Since the material resists mild acids, alkalies, and extreme temperatures, it is recommended for use in chemical plants and other industrial buildings where breakage is a problem.

Available both clear and tinted green in standard 0.060 and 0.085 inch thicknesses, Polyglaze comes in sheets up to 48 by 144 inches. Some characteristics are:

Barcol hardness	40–50
Specific gravity	1.40–1.45
Tensile modulus of elasticity, psi	1.3×10^6
Flexural strength, psi	24,000
Shear strength, psi	11,000–14,000

Readers' Service Item 6

Modified Fluorocarbons

Radiation Applications, Inc., has developed a process, called Raibond, which involves treating fluorocarbons to impart a clear, adhesive-, ink-, and dye-accepting surface. It has been used between metal and plastic components of microwave transmission systems, where it makes possible a stronger, more elastic bond. The product is said to permit the use of newly-developed adhesives, with substantially increased low-temperature flexibility, in waveguide equipment.

Raibond is especially recommended to users of fluorocarbon wire insulation; Teflon and Kel-F tapes, films, and sheets; and Teflon molded parts which require color coding or bondable surfaces. Radiation Applications can apply Raibond to your material, or can supply Teflon and Kel-F sheets, film, and rods which have already been converted.

Readers' Service Item 7

Film-Grade Polyethylene

Two types of film grade polyethylene have been made commercially available by the polymer chemicals division of W. R. Grace & Co. Both resins yield films and sheet which may be treated, printed, and heat sealed with conventional equipment.

Grex 2001 (density 0.940) can be extruded in films thinner than one mil. Recommended for overwrap and bag applications, its stiffness, in comparison with lower density resins, eases handling on automatic equipment. Other characteristics of the resin are:

Melt index	4.0
Dart impact strength, 1¼ mil film, oz.	1.8
Haze, 1¼ mil film, %	13
Coefficient of static friction	0.4
Elmendorf tear strength, gms./mil, MD	20
Softening point, °F	250

The other resin, in glossy white, is intended for extrusion of heavy film or sheet (4-10 mils) to produce specialty packages that replace paper carton stock, and for production of thermoformed packages with heat-sealed lids. Chill roll casting yields rigid sheet or film with a high gloss. Thermoformed sheet packages withstand the requirements of freezable packages and can be used in packaging frozen, boil-in-package foods.

Properties of printing, white grade Grex 60-050E White 2-40 follow.

Density	0.960
Melt index	5.0
Water vapor transmission, 5 mil film, g./100 sq. in./24 hrs.	0.06
Gloss, cast film, % @ 60°	95
% @ 45°	57
Tensile strength, cast film, psi. MD	2900
CD	1700
Elmendorf tear strength, cast film, gms./mil, MD	21
CD	54
Dart impact strength, 5 mil cast film, oz.	5.5
Softening point, °F	270
Gurley stiffness, 5 mil cast, film, mg.	160

Readers' Service Item 8

Flame Retardant Insulator

A flame retardant version of a cellulose base fiber insulating material that does not appreciably differ from the original grade in dielectric and mechanical strength has been developed by Rogers Corp. Designated Duroid 225 FR, the material is reported to extinguish itself in less than five seconds.

The manufacturer claims the following specifications for the material, which is available in standard thickness of 0.031, 0.062, 0.093, and 0.125 inches.

Dielectric strength, maximum vpm, dry	350
At 7% mc.	200
Arc resistance, seconds	75–100
Tensile strength, psi., MD	17,000
TD	6,000
Burst strength, psi	1,800

Readers' Service Item 9

Rigid Plastic Pipe Resin

Cycolac LL, an ABS material with superior impact strength at normal and low temperatures and excellent long term burst strength, has been developed for extruded pipe by Marbon Chemical Division, Borg-Warner Corp. White LL is reportedly equivalent or superior to ABS Type I materials in all respects, it does not equal ABS Type II in long term fiber stress and rigidity. Therefore, it is recommended for pipe requiring superior impact resistance, resistance to abuse, and ductility.

During extrusion, temperature limits of 380-440° F. should be followed. Predrying of LL is necessary before extrusion. Fittings of ABS Type I and Type II are suitable. Average physical properties follow.

Tensile strength, psi., 160° F.	3300
−40° F.	7800
Tensile modulus, 73° F., psi.	210,000
Flexural modulus, psi., 160° F.	190,000
−40° F.	240,000
Flexural yield strength, psi., 160° F.	4700
−40° F.	11,000
Hardness, Rockwell R	86
Specific gravity	1.04
Izod impact, notched, ft. lbs./in., 73° F.	8–10
−40° F.	2.5
Unnotched, 73° F.	>40
Heat distortion, °F., specimen ½ x ½ x 5 in., Unannealed, zero load	223
66 psi.	208
264 psi.	196
Annealed, zero load	241
66 psi.	230
264 psi.	224
Coefficient of linear thermal expansion, in./in./° C.	10.1×10^{-5}
Mold shrinkage, %	0.5
Power factor, 60 cycles	0.005
10^6 cycles	0.006
Volume resistivity, ohm-cm.	$>3.5 \times 10^{16}$
Quick burst, 72° F., psi.	6150
Step burst, 72° F., psi.	1600
Extrapolated (10^5 hrs.) fiber stress, R.T., psi.	2100

Readers' Service Item 10

White Epoxy Surface Coat

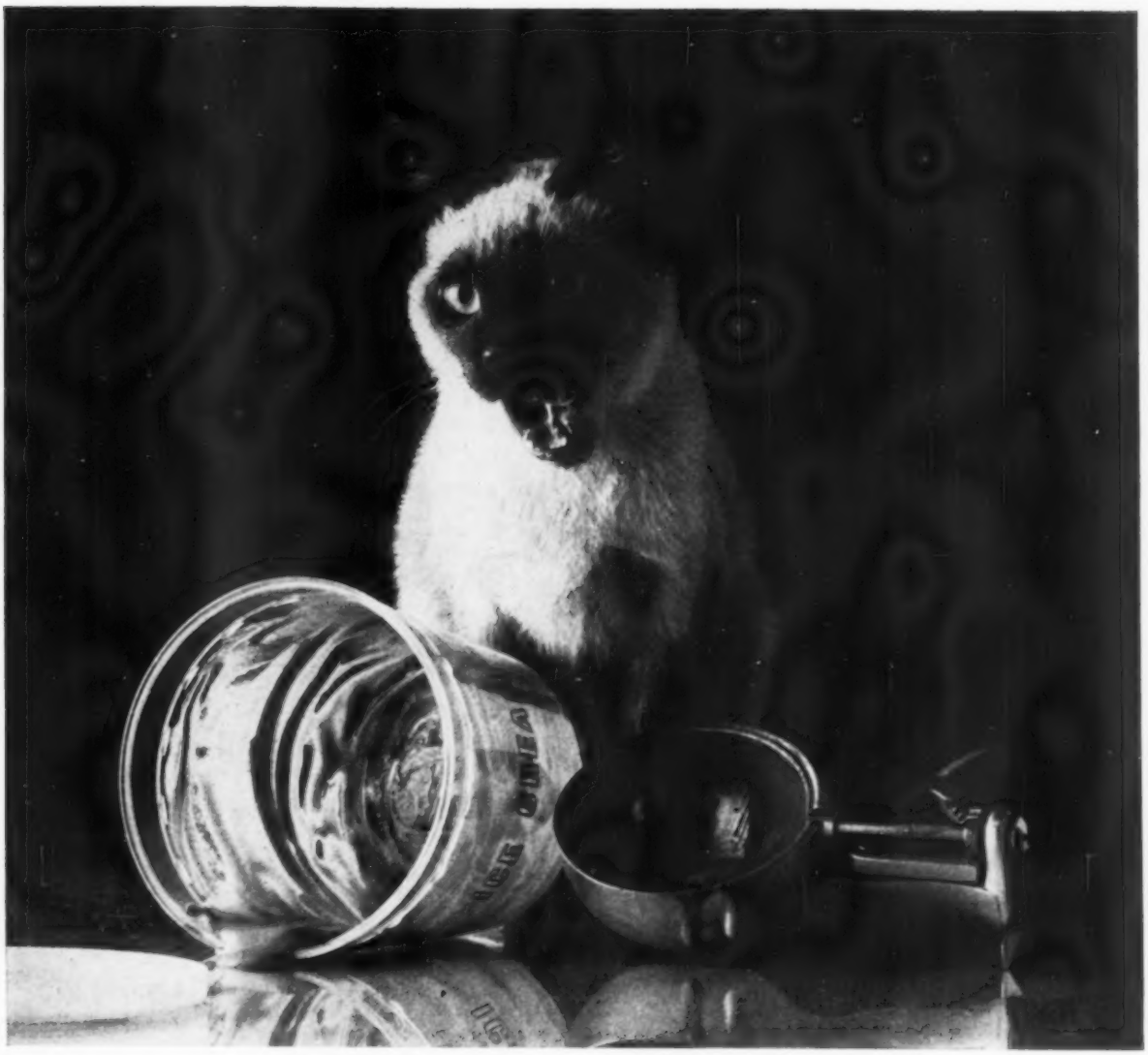
A white epoxy surface coat formulation with a smooth texture has been added to the line of tooling plastics manufactured by Ren Plastics, Inc. Ren RP-1125 Surface Coat can be applied with putty knife, spatula, paddle, or brush in layers as thin as paper up to ⅛ inch.

This thixotropic coat is recommended for vertical surfaces. Since it can be built to contour easily, it may be splined or used on male or outside corners.

Laminating may be started as soon as the paste is applied. Viscosity both before and after adding hardener is pasty. Pot life is 18 to 22 minutes. Laboratory testing indicated these average properties.

Specific gravity	1.38
Rockwell hardness, M	76
Compressive strength, ultimate, psi	11,800
Flexural strength, ultimate, psi.	10,700
Tensile strength, ultimate, psi.	5,800
Heat distortion temperature, °F.	134
Modulus of elasticity in flexure, psi	0.64×10^6

Readers' Service Item 11



NOW RIGID VINYLS CAN BE MADE NON-TOXIC

Argus announces three new products—*non-toxic* stabilizers that *withstand the high heat needed to process unplasticized vinyl.* They provide stability superior to that of any non-toxic stabilizer previously available. All three are approved by the Food & Drug Administration.

The new, non-liquid stabilizers—Mark 33, Mark 34 and Mark 35—may be used in rigid compounds as the sole stabilizer system, and give excellent stability. They do not require the addition of epoxidized oils. Thus, they avoid the reduction in heat distortion temperature level and the loss of other important physical properties that occur with liquid-type stabilizers. They are suggested for use in extruded thin unplasticized film, rigid calendered sheet and plasticized non-toxic products.

Mark 33 gives exceptional long-term heat stability in rigids. It is recommended for pigmented or darker stocks. *Mark 34* is recommended where crisp, initial color is required, and provides good clarity. *Mark 35* gives better initial color than Mark 33, and longer stability than Mark 34.

Call or write for more information and bulletin.

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Asbestos-Phenolic Laminate

Thermomat, a non-woven asbestos felt saturated with a thermosetting phenolic and an inorganic filler, is available from Johns-Manville in sheet form for one-piece lay-up. Designed for production of components that must withstand tremendous heat and pressure, such as aviation, rocket, and missile parts, Thermomat is flexible before curing. It dries to a tough, rigid state in which it is claimed to be extremely resistant to high temperatures and to offer exceptional resistance to physical abrasion and erosion during ablation.

Eight styles of Thermomat, with chrysotile or crocidolite fibers, are currently available. A typical low pressure cure cycle would be 300° F. at 100 psi. for 15 minutes for each ¼-inch thickness of finished material. Mold temperature and press time would remain the same at higher pressures. For maximum physical properties, a post cure, such as 16 hours at 300° F., followed by 16 hours at 350° F., is desirable.

For most effective ablative and erosion properties, Nos. 193 or 207 are recommended, the former for molding at low pressures and the latter at high pressures. Where erosion exposure is at a minimum, other styles, especially No. 197, are recommended. This style, cured at 100 psi. at 300° F. for 15 minutes followed by a post cure of 24 hours at 300° F and 66 hours at 350° F., showed the following properties.

Density, pcf	106
Tensile strength, psi	15,474
Modulus of elasticity (in tension)	2.14×10^6
(Edgewise compression)	1.32×10^6
Modulus of rupture (ultimate flexural strength), psi	25,300
Shear strength, psi	20,300
Coefficient of thermal expansion, in./in./°F., 70-400° F. range	5.51×10^{-6}
Compression strength, edgewise, psi	24,500
Flatwise, psi	50,300
Rockwell hardness, E scale	94
K scale	74
Barcol hardness	85
Thermal conductivity, BTU in./hr.-sq. ft., °F	2.5
Izod impact strength, ft. lbs./in. notch, thickness 0.206 in.	2.59

Readers' Service Item 12

Stiff Polyethylene Resin

For most blow and injection molding applications, U. S. Industrial Chemicals Co. is producing Petrothene 101. According to the company, the most important properties of 101 are high stiffness, good stress crack resistance, excellent appearance, and easy processability. Experimental Boston round bottles blown with 101 were characterized by gage uniformity at the parting line and maximum strength at the weld line.

Melt temperatures between 300 and 310° F. are recommended for extrusion blow molding with Petrothene 101. Mold cycle time will depend upon mold size, among other variables. The following average physical properties have been determined.

Density, g./cu. cm.	0.924
Melt index, g./10 min.	2.0
Tensile (20 in./min.) yield, psi	1,770
Break, psi	1,640
Elongation, %	500
Low temperature brittleness, °C., F50	<—76
Vicat softening point, °C.	100.0
Torsional stiffness, psi	53,700

Readers' Service Item 13

Thixotropic Epoxy Putty

A thixotropic putty, which cures at room temperatures into a solid chunk of epoxy resin, is recommended by Narmco Resins & Coatings Co. for trimming the edges of lightweight sandwich panels. Narmco 3150 putty may be applied with a putty knife or caulking gun onto the exposed edge of a honeycomb between two sandwich skins, after which holes may be drilled for fastening.

This two part system will begin to harden within 15 minutes of mixing. After three hours at room temperature, it has reached a Barcol hardness of 53-60, and may be drilled, tapped, or sanded. Production of optimum mechanical strengths requires additional curing at temperatures up to 250° F. Specific gravity of the cured epoxy is 1.43; density is 90 pounds per cubic foot. It may be used, according to the producers, at temperatures up to 200° F. with only slight loss in properties. Cast bars show a compression strength of 18,000 psi. and tensile strength of 9,000 psi.

A related application for Narmco 3150 is in casting plugs within sandwich panels for insertion of fasteners. The putty is injected into a cavity through a hole drilled in the skin. A fastener may be inserted immediately or installed after curing.

Readers' Service Item 14

Irradiated PE Film

An irradiated polyethylene film, characterized by energetic shrinkability, has been developed by W. R. Grace & Co.'s Cryovac division. Suited for packaging produce, meats, and other foodstuffs, the film may also have a potential for standard overwrap packaging of many consumer products.

The film is prepared by bombardment with up to two million volts from a General Electric electron beam generator. Electrons hitting the extruded tape change the molecular structure of the polymer, causing it to become cross-linked like a tightly woven fish net. This reportedly increases the strength of the material more than 500% and makes possible biaxial orientation of more than 200%. When exposed to hot air or water at 180° F., the film immediately shrinks by 20%, and continues to shrink equally in all directions as the temperature is increased.

Thus, the film can be used with packaging techniques which use shrink energy to do much of the wrapping and sealing of the package itself.

The film is not radioactive after it leaves the generator, and is identical chemically with conventional polyethylene foodstuff wrapping.

Irradiated film is sold in transparent rolls from 0.0005 to 0.0013 inches thick and up to 48 inches wide. Properties include:

Specific gravity	0.92
Tensile strength, lb./sq. in.	8,000–16,000
Elongation, %	60–90
Burst strength (Mullen) lbs./sq. in.	35–45
Tear strength (Elmendorf) gm./mil	10–15
Heat sealing range, °F.	300–500
Water absorption, 24 hr. immersion, %	0
Water vapor permeability, gm./24 hr./100 sq. in., 100° F., 90% R. H.	0.6–0.7
Maximum use temperature, °F.	220
Minimum use temperature, °F.	—60
Shrink temperature range, °F.	170–210
Unrestrained shrink, 205° F., %	35–50
Shrink tension, 205° F., psi	250–450
Haze, %	0.8–1.2
Gloss (Photovolt), 70° angle, %	103
Diffuse reflectance	0.6–0.7
Voltage breakdown, 3/4 mil film, volts/mil	3,500
Conductivity, ohm-cm	10^{18}
Dielectric constant	2.35–2.40
Loss tangent	0.00015–0.0005

Readers' Service Item 15

Rigid Vinyl Copolymer Resin

Prestovin 1004, a resin composed of vinyl chloride (96%) copolymerized with vinyl stearate and two other vinyl monomers, has been developed by J. P. Frank Chemical Corp. specifically for pipe, conduit, and fittings.

According to the manufacturer, the resin's internal plasticization and lubrication enhance processability. Rapid fluxing and extrusion and superior flowability are reported to yield excellent surface smoothness and gloss. These characteristics recommend the resin for difficult extrusion and multi-cavity molding operations.

For most operations, no processing aids are necessary. Furthermore, since the resin is inherently stable, a lower level of stabilizer may be used. Average properties follow.

Bulk density, gm./cc.	0.58
Relative viscosity, 2% THF solution, approx.	4.50
Specific viscosity, approx.	3.50
Typical sieve analysis, % on 40	0
% on 200	85
% through 200	15
Heat distortion, °F.	168

Readers' Service Item 16

DRAPEX 7.7 BLOCKS STAINING—2 WAYS

Drapex 7.7, a primary plasticizer with polymeric properties, gives vinyls built-in resistance to stains. It *blocks stain penetration* from the top surface down and from the underside up. This explains its growing use in such vinyl products as floor tile and upholstery.

The low solvating rate of most polymeric plasticizers often causes processing difficulties. Because Drapex 7.7 has a very high rate of solvation, this problem is largely overcome. Similarly in plastisol or organosol coated fabric, through the use of Drapex 7.7 to increase fusion rate, polymeric properties may be obtained without the usual stringent heat conditions which often cause scorching of the fabric backing.

Drapex 7.7 gives vinyls low volatility and excellent resistance to extraction. Recommended for products coming in contact with chemicals—tank linings, vinyl coated gloves, etc.—and where resistance to lacquer marring is important.

Write for technical bulletin on Drapex 7.7 including results of stain tests.

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New Equipment

For more information check Readers' Service Card (p. 103)

Egan multiple belt pipe pulling unit.

Multiple Belt Pipe Puller

A multiple belt, tractor-type pipe pulling unit, designed by Frank W. Egan and Co. for rigid PVC, Kralastic, and large size polyethylene pipe, will handle diameters up to 24 inches. The puller, which receives the pipe as soon as it is extruded, reduces pressure required for extrusion.

The number of belts depends on the size range of the unit. The minimum three-belt machine will pull pipe of ½- to eight-inch diameters, while the six-belter will handle diameters of two to 13 inches. Larger sizes must be custom ordered. Merely turning a handwheel on the machine adjusts it for different pipe sizes. Belts are of the non-slip type, such as Gilmer Timing Belts.

Dimensions of the six-belt machine are 42 by 44 by 66 inches.

Readers' Service Item 21

Rotary Injection Machines

Barclay Industries, Inc., is importing Nora rotary injection molding machines P. 15, with injection capacity of 15 grams (approximately ½ ounce), and P. 50, with injection capacity of 50 grams (approximately 1¾ ounces). The machines feature rotary turret heads which index automatically after each injection, thus eliminating cooling time.

Up to six molds can be in production simultaneously. A single screw preplasticizing unit is incorporated into the machine. While the standard screw and nozzle will handle most ordinary thermoplastics, special ones can be ordered. Water cooling at the oil tank, bottom and top molds, and feed hopper end of injection screw is regulated by controls on the front of the frame. A thin hook, pushed into each injection aperture by a special piston, removes sprues in the first, second, or third cooling position.

Four injection pressure ranges, from a maximum of 8,700 psi. for easily workable material such as polyethylene to a maximum of 17,000 psi. for very viscous material such as PVC, are controlled by an adjustable valve and proper screw and barrel selection.

The hydraulic pump system is fitted below the injection unit and consists of an 18 hp. electric motor and a pump with a capacity of 13 or 18 gallons per minute respectively, working at 1,000 psi. Oil tank capacity is 50 gallons.

Specifications of the Nora rotary injection molding machines follow.

	P. 15	P. 50
Locking pressure, tons	15	50
Injection volume, max., cu. in.	0.9	3
Hydraulic pressure, psi.	996	996
Shots per minute	30-34	15-20
Plasticising capacity, lbs./hr.	30	65-85
Heating wattage, kw.	3.05	4.85
Hp. of motors	10	12
Power consumption, 220/380 V., 50 cycles, kw.	11.35	14.65
Size of molds, round, diameter, in.	6.3	7.87
Square, in	6.3 x 6.3	7.87 x 7.87
Height of molds, in.	5.12	5.91
Opening stroke of molds, in.	5.91	9.05
Dimensions		
Length, in.	110	118
Breadth, in.	43	43
Height, in.	71	79
Weight, lbs.	6,200	7,300

Readers' Service Item 22

Pivoting Chop Saw

Commercial Tool & Die Co. is marketing a chop saw for mitering and straight cut-off of extruded plastics, fiberglass, and other materials. Set on a small base for flexible mounting, the S-200 will accommodate abrasive, metal-cutting, or wood-cutting blades with diameters to 10 inches on ⅝-inch arbor.

Pivot shaft is mounted on pre-loaded bearings. Permanent alignment between arbor and pivot is assured by the one-piece, close-coupled casting. Hazards are lessened by an adjustable telescoping blade guard, enclosed belt drive, and pivoting guard.

Cutting capacity is 1 by 8 inches or 2 by 7 inches on straight cuts and 2 by 5 inches on 45° cuts. Size of belt guard enables interchanging drive pulleys for several blade speeds. Saw is 21 inches long and 12 inches wide. Motor mount slots accommodate motor slots to one hp.; 1½ hp. motors require mounting plates.

Readers' Service Item 23

High-Production Heat Sealer

According to Tronomatic Machine Mfg. Corp., the Double Shuttle Heat Sealer was developed to fulfill a need for an automatic and still faster blister package sealer. Loading trays carry assembled packages into the sealing area. After they are sealed, they are discharged by the shuttle table. Production capacity is controlled by the loading operation, which may be conveyor-fed for accurate inline automated programming.

The sealer features an emergency stop to insure safety. It has a floor area of 25 by 80 inches, and height of 72 inches. Electric current is single or three phase, 220 volts, 2400 watts. For a sealing area of 14 by 22 inches, 0.28 cubic feet of air at 80 psi. are required per cycle.

Readers' Service Item 24

Single Reel Take-Up

Davis-Standard, division of Franklin Research Corp., is producing a single reel take-up for wire insulating lines. Model SR 36, designed for wire speeds up to and exceeding 2,000 fpm., will accommodate reels from 21 to 36 inches in diameter and up to 24 inches wide. Reels weighing 2,000 pounds can be handled at 90 psi. air pressure.

Reels are raised and lowered pneumatically, using a lever-operated four-way valve. Traverse lay is reversed by air-operated counter-rotating clutch. Variable pitch pulley drive provides stepless adjustment of lay from 0.10 to 0.50 inches wire diameter. Adjustable ball-bearing mounted guide rolls accommodate wire diameters up to ¾ inch. The ¾-inch dog pin adjusts from 3 to 6 inches from center of reel bore.

Readers' Service Item 25

Portable Thread Mill

Plastics such as nylon or Teflon can be thread-milled with or without coolants by the Fen-Thread-Miller. Manufactured by Fen-Thread-Machine Co., Inc., it can be attached to any lathe and will thread up to the shoulder without undercutting. Only one pass is required to thread-mill any 60°, Acme, or square thread. Pitch diameter, root, and pitch angle are held to a tolerance of 0.001 inch.

Cutters available range from 1/32-9 inches for external threading, and from ½-9 inches for internal threading. Any 9-20 inch screw cutting engine lathe can be used with the thread-mill to cut 4-200 threads per inch.

Readers' Service Item 26

Heavy Duty Dissolver-Mixer

J. H. Day Co., division of Cleveland Automatic Machine Co., has introduced into its line of processing machinery a dissolver for mixing extra-viscous solutions. Known as the Daysolver, the mixer is built with a heavy duty steel column, frame, and bridge, and a stainless steel impeller shaft. It is reported to provide vibrationless operation under extreme work loads.

The bridge swings in a 240° arc, permitting almost continuous operation. A hoist, operated by 80 pounds of air pressure and cushioned at both ends of the stroke by an oil hydraulic circuit, raises and lowers the shaft and impeller. The Turbopeller, one of a variety of impellers offered, combines five different mixing actions. Two speed or variable speed drives are supplied.

The Daysolver is made in seven sizes for production, as well as a laboratory model. Specifications of the smallest and largest, with respective maximum capacities of 50 and 200 gallons, follow.

	225-V	400-M
Horsepower	5-10	40-75
Impeller, rpm	400-2,000	595 & 1,1190
Standard impeller shaft rise, in.	42	48
Filtered air supply for hoisting, cfm., 80 psi	2	4
Standard impeller diameter, in.	10	15
Impeller shaft diameter, in.	2¼	4
Height, in.	67⅜-109⅞	81½-129½
Length, in.	75$^{13}/_{16}$	77⅝
Width, in.	18⅛	25⅛
Distance from floor to bottom of impeller, in.	3-47	7-55
Hoist column to center of impeller shaft, in.	30$^{21}/_{32}$	31½

Readers' Service Item 27

Portable Mask Washer

Conforming Matrix Corp. has added a small portable mechanical mask washing machine to its line. Designated Model W-1500-S, it washes masks up to ten inches square in a few seconds. Solvent is agitated by an air motor requiring from 2-7 cfm. The tank has a capacity of about seven gallons.

A screened bottom, removable for cleaning, permits solids to settle. Installation requires connecting a ¼-inch air hose to the motor.

Readers' Service Item 28

Caterpillar Capstan

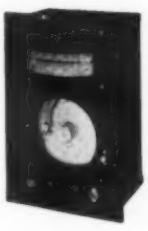
A general purpose caterpillar capstan for large diameter wire and cable insulating lines is available from Davis-Standard, division of Franklin Research Corp. Model MDC will pull up to 2,500 pounds at speeds up to 250 fpm.

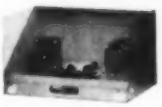
SPECIFIED
FOR MAKING SEMI-CONDUCTORS

Gardsman by WEST

Model JSBG Stepless Program Controllers

Part of diffusion furnace room, Hoffman Electronics Corporation, El Monte, California. Process is one step in critical manufacture of silicon solar cells.





Semi-conductors are grown by a highly integrated process, involving time-temperature control. Only the most precise control delivers the required quality, uniformity, efficiency.

Leading producers of semi-conductors find best results from the market's most compact, integrated Stepless Program Controller: by West. This unit infinitely modulates heater power *and* coordinates time-and-temperature control for even the most unstable systems.

Also available: models combining Gardsman off-on, proportioning or 3-position controllers with programming. All are *tubeless* and noted for minimum maintenance and operating requirements. Ask your West representative or write for Bulletin JSB and JG.

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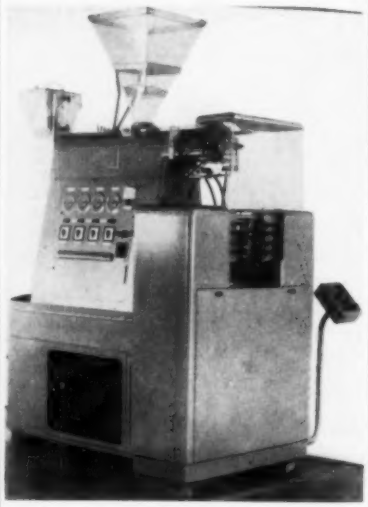
Represented in Canada by Davis Automatic Controls, Ltd.

the trend is to WEST

KAUTEX

Blow Molding Machines



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NO Continuous Royalties!

U. S. Patent Structure

#2,810,934 PLAX (Bailey)
#2,898,635 OWENS-ILLINOIS (Burch)
#2,787,023 KAUTEX (Hagen)
435,547 KAUTEX (Hagen)
793,045 KAUTEX (Hagen)

- Price includes a fully paid, protected license to use.
- KAUTEX is the world's largest seller of Blow Molding Equipment.
- Available in 6 sizes (1/30 oz. to 50 gals.) with and without extruders.
- Single and double extrusions and low mold costs.

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GUARANTEE

Some Sales Area Available

Kautex — U. S. Sales Co., Inc.
Flushing 54, N. Y. LEnox 9-3000

Tread is designed to wrap around cable automatically for diameters from 5/16-5 inches. Pneumatically-controlled tread pressure up to 400 psi. is available on 70-75 pounds of air. Upper and lower treads open and close on a common centerline for precise horizontal alignment. Horizontal and vertical guide rollers center cable in tread. Maximum cable speed is 100 or 250 fpm, infinitely variable down to 1/61 of maximum speed. A lead wire drum capstan for starting cable through the capstan treads is optional.

Floor space of 42 by 70 inches is required. Total width is 87¾ inches. Height is 59 inches. Motor horsepower and speed ratios must be specified.

Readers' Service Item 29

Pincer-Type Blow Molders

Newark Plastic Machinery Corp. has announced the commercial availability of the Newark-Granbull two- and four-unit blow molding machines with clam shell type mold closures. Adaptable by means of a single or double vertical head to standard two-inch or larger extruders, the machines will mold round containers with capacities as large as 40 ounces, and square containers holding up to 50 ounces. Each unit operates independently, making it possible to blow two different articles simultaneously, or to run one unit singly.

Air operated at 60-80 psi., two units will use approximately 16 cfm. free air at a rate of 40 cfm. Platens are 6¼ inches wide and 9¼ inches high. Space between closed platens is 5½ inches. Height from top of platen to base is 31 inches. The two-unit model requires floor space 18 by 80 inches, while the larger one occupies 51 by 80 inches. Steel bases, of which the four-unit model requires two, measure 4 by 18 by 80 inches. For running extra cavities, extractor assemblies and double vertical cross heads to suit extruder can be supplied.

According to the manufacturer, the two-unit machine used in conjunction with a two-inch extruder producing about 45 pounds per hour will produce 750 two-ounce (56cc.) containers weighing 0.3 ounce per hour, or 720 four-ounce (112 cc.) containers weighing 0.5 ounce per hour. Production can be doubled by using the double head and extra cavities. With a single head, approximate production rate of 40-ounce (1120 cc.) containers weighing three ounces is 240 per hour.

Readers' Service Item 30

Motorized Micrometer

According to Testing Machines, Inc., the motorized dead weight micrometer makes possible more precise thickness measurements of sheet materials. Unlike manual spring-operated, screw type, or hand-operated micrometers, the motorized micrometer assures that the dead weight measuring load is always applied in the same way and with the same pressure. The cam which lowers the dead weight load loses contact with the load during the period when the measurement is being noted. Thus, only the dead weight exerts pressure on the sheet.

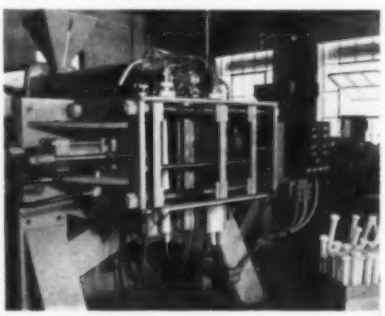
Cycling time for each measurement is five seconds, but other speeds can be furnished.

Readers' Service Item 31

Blow Molding Machines

Acme Machinery and Manufacturing Co., Inc., has acquired the exclusive distributorship of Trico blow molding machines 1216 A and 1824 A. Both can be adapted to any extruder and come with two or four nozzles. Three West instruments control the temperature on the heads. Separate automatic timing control to each platen opening and on air to nozzles is provided. Dry cycle is approximately two seconds.

Model 1216 A operates on a 1,000 psi., 2 hp. Webster electric hydraulic system; 1824 A on a 2,000 psi., 2 stage hydraulic system. Opening between platens on 1216 A is 10 inches; on 1824 A, to customer's specifications. Clamp cylinder diameter on Model 1216 A is 4 inches; parison on 1824 A is 6 inches. Diameter capacity on two-nozzle head, both machines, is 3¾ inches. On four-nozzle head, 1216 A (with platens 12 by 16 inches) has a capacity of 2 inches; 1824 A (with platens 18 by 24 inches), 2½ inches.



Trico blow molding machine.

Readers' Service Item 32

Rotary Shelf Ovens

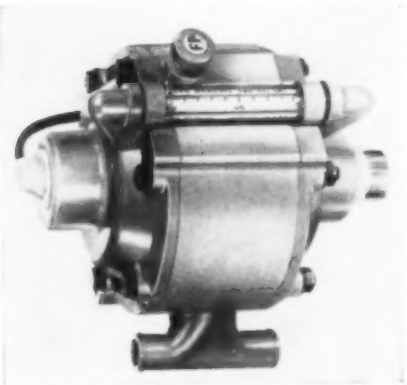
For laboratory or production work requiring precision control of heat uniformity, Despatch Oven Co. has made available a rotary shelf laboratory oven. The rotary shelves, either manually or mechanically operated, are spaced on 12-inch vertical centers. Manual operation is suggested for operation below 300° F., while for temperatures up to 850° F., a motor and reduction gear is provided to maintain constant rotation.

The revolving shelves are adapted to "V" series ovens, supplied for gas, electric, or steam heat.

Readers' Service Item 33

Plastics Applications

For more information check Readers' Service Card (p. 103)



Solution feed manual gas dispenser.

Molded Gas Dispenser

A solution feed manual gas dispenser, molded from PVC or Kralastic in 13 parts, is reported to equal or surpass metal dispensers in service life and performance. Fabricated by U. S. Gasket Co., plastics division of Garlock Packing Co., for Fischer & Porter Co., the unit is used for industrial chlorination of water or for large commercial swimming pools. It mixes water and chlorine in predetermined ratios.

Weighing slightly over two pounds, the dispenser has only one moving part. Fabrication to close tolerances assures operational efficiency and eases interchanging of parts.

Readers' Service Item 41

Thinner High Fidelity Records

A high fidelity record, less than one-eighth the weight and thickness of conventional records, will be available in this country through a combine of British, French, and American companies. The records will be produced by Rank Audio Plastics, a division of Rank Records of America, Inc. The J. Arthur Rank motion picture group and Librairie Hachette own the company. Consolidated Litho Corp. has been licensed as the exclusive United States manufacturer.

Made of unbreakable PVC, each record weighs one-eighth of an ounce and is four-thousandths of an inch thick. Designated Rank T.U.P. (Thin Unbreakable Plastic), they will be sold in a basic seven-inch diameter in 33⅓, 45, and 78 rpm. speeds.

Rank T.U.P. records are expected to find applications in publishing, education, drama, music, promotions, and direct mailings. They can be incorporated in books and magazines, such as theatre programs, stockholder reports, and political publications. They will be available in white and black, and color printing and embossing on the center or playing areas can be ordered.

Readers' Service Item 42

Air-Supported Vinyl Enclosure

An inflatable vinyl enclosure, called Space-Arena, has been developed by Plastimayd Corp. for use as a swimming pool enclosure or as a covering for outdoor storage or construction projects. Air-supported by a 0.1 hp. blower, the shelter is constructed from transparent, flexible, Krene vinyl sheeting. Heat can be supplied by a small electric heater.

The Space-Arena, which reportedly can be erected in less than two hours by two people, is held in place by water tubes constructed in the base and/or sand bags. Entrance is through a zippered doorway. Side walls rise eight feet on standard models. Ceiling is approximately 12 feet high at the center. Besides offering standard sizes up to 40 by 60 feet, the manufacturer will custom-make any larger rectangle.

Readers' Service Item 43

Nylon Air Dome

The Air:Seal Airhouse, an air-supported, vinyl-coated nylon structure, is in production by the industrial products division of Seattle Tent and Awning Co. The fabric, produced by Cooley, Inc., is coated with a plastisol based on B. F. Goodrich Chemical Co.'s Geon vinyl resin.

Air:Seal Airhouse.

Seattle Tent and Awning Co. has found that an Airhouse 60 by 110 feet with a 30-foot center height could be both heated and supported by a 450,000 BTU portable heater. For support purposes alone, cage-type blowers are used.

On a concrete base, the Airhouse is anchored with a metal ballast ring. Deep-soil spear/cable to heavy duty pipe is used in attaching to dirt, macadam, sand, and any other base except concrete.

Four doorway styles are available: personnel, general foot traffic; vestibule; truck vestibule; and bat wing, for lift truck usage.

Readers' Service Item 44

Polyethylene Package

Kaiser Aluminum & Chemical Corp. is encasing shipments of clean aluminum pig and ingot bundles in polyethylene packages to prevent dirt or moisture contamination. The bags are secured over the bundless with 1¼ inch steel straps at the reduction plants. The package allows the bundles with 1¼ inch steel straps at the

The package permits circulation of air, thus preventing condensation from forming within the wrap during shipment or storage.

Readers' Service Item 45

Swimming Pool Cleaner Hose

A flexible vacuum cleaner hose for swimming pool maintenance has been introduced by Dayton Rubber Co. Known as Dayco Nylaflex, the hose is designed for pool vacuum and filtration use. It can be used for filling and emptying the pool as well as cleaning.

The hose is constructed of a steel spring wire, a vinyl inner sleeve, and a PVC outer sleeve, which will not mark or scuff pool walls or walks. It is sold in a variety of colors in 1½ and 1¼ inch diameters and 40 and 50 foot lengths.

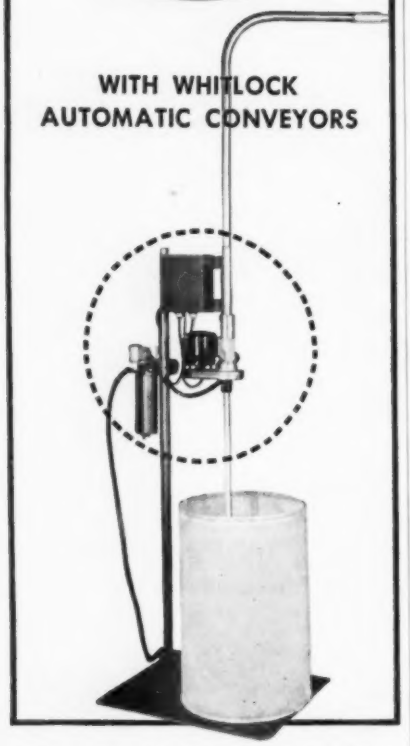
Readers' Service Item 46

Extruded Nylon Film

United States Gasket Co., plastics division of Garlock Packing Co., is presently marketing extruded nylon film and sheet in thicknesses from 0.002 to 0.060 inches and in widths up to 18 inches. The heat-sealable film has already been used as a food wrapping, especially for meats. Since it is available in unlimited lengths, the nylon is recommended for mass production stamping of thrust bearings, electric insulators, oil bearing items, and backup rings. Also, manufacturers of equipment using scuff, skid, or kick plates, or other anti-friction components can fabricate parts from the film.

Readers' Service Item 47

WITH WHITLOCK
AUTOMATIC CONVEYORS



Pellets or re-grinds, the air controls on Whitlock automatic conveyors keep your hoppers always loaded—never over-loaded!

Model 1012 (shown above) features:

- Automatic hopper loading
- Rotating Venturi Tube for materials that tend to bridge
- Capacity up to 1,000 pounds per hour
- Self-supporting for fast, easy installation

Whitlock conveyors are available in 24 different models, pneumatic operation with automatic or manual controls, and capacities from 400 to 2,500 lbs. per hour. Write for full details.

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Whitlock

60—F

WHITLOCK ASSOCIATES INC.

21655 Coolidge Hwy, Oak Park 37, Michigan

Vinyl Sheeting for Windows

Tox-Shade, a glare- and heat-reducing vinyl sheeting, is now available for windows as large as 48 by 72 inches. According to Toch Brothers, this durable sheeting effectively screens out glare in work areas and prevents excessive temperature build-up from direct exposure to sunlight at a cost below that of window shades.

Available in several transparent, translucent, and opaque colors, the sheeting is furnished to individual window dimensions, and applied without adhesive. It is claimed not only that the bond will last indefinitely, but that Tox-Shade can be stripped and reapplied without becoming brittle or losing its bondability.

Readers' Service Item 48

Urethane Foam Mixing Kit

A do-it-yourself kit for mixing urethane foam is now available for home handymen and boating enthusiasts. Packaged by Dayton Rubber Co., the kits contain premixed chemical components capable of creating lightweight, rigid urethane foam to fill areas as small as a cubic foot. After the chemicals are mixed in the provided container, they will expand to 30 times the original volume within ten minutes. The resulting foam clings to any surface.

In the minimum quantities useful on small boats for filling and extending flotation chambers, insulating cabins, and reinforcing structures, the formulation may be used without precise metering and mixing equipment. However, automatic metering and mixing equipment can be supplied for large scale use by marine construction firms.

Readers' Service Item 49

Nylon Eductor Valve & Body

An automatic water softener made by Culligan, Inc., contains an injection molded nylon valve. Consisting of a nylon eductor housing, eductor body, and cap, the valve acts as a venturi, valve seat, and closure.

The venturi draws up to 29 inches of mercury. To avoid irregularities, which would impede function, the venturi's ⅜-inch diameter outlet was molded without parting lines of any type by Chicago Molded Products Corp.

The nylon valve is forced to withstand high water pressures: a working pressure of 150 psi., surge pressure of 300 psi., and burst of 600 psi. Burst pressure on these valves is reportedly greater than 1,200 psi. Since the nylon will not corrode, the smooth, clean surface, and thereby the efficiency of the operation, is maintained.

Readers' Service Item 50

Jaylis Traversing Window Covering.

Traversing Window Covering

Jaylis Sales Corp. has developed a window covering reported to combine the functions of blinds, draperies, and curtains. Composed of three-inch squares of Styron 672 Verelite (Dow Chemical Co.'s light-stabilized polystyrene) molded in a three dimensional pattern, the blind is suspended on nylon rollers from standard heavy duty drapery track.

Since any number of squares can be interlocked with spring steel rods, the covering permits custom sizing. It can be as high as 16 feet, and as wide as 32 feet, and can be used as a room divider or folding door as well.

The semi-translucent blind provides ventilation by means of molded-in horizontal vents. It is claimed to tolerate years of sunlight.

Readers' Service Item 51

Nylon Garden Hose Coupling

W. D. Allen Manufacturing Co. has marketed a quickly-attachable coupling which enables the purchase of garden hose in any desired length. Hose is cut as desired, and coupled on the spot with Zytel 101 nylon coupling.

The coupling, including a slip-over ferrule for greater strength, is installed by hand. It is available in diameters of ½, 7-16, and ⅝ inch.

Reattachable nylon hose coupling.

Readers' Service Item 52

Molded Nylon Screws

Gries Reproducer Corp. has added three small nylon screws to its line of molded fasteners. The screws can be ordered from stock in #0-80 (⅜ inch), #1/72 (½ inch),

for FASTER HEAT TRANSMISSION

- LESS LAG
- LOW COST
- LIGHT WEIGHT

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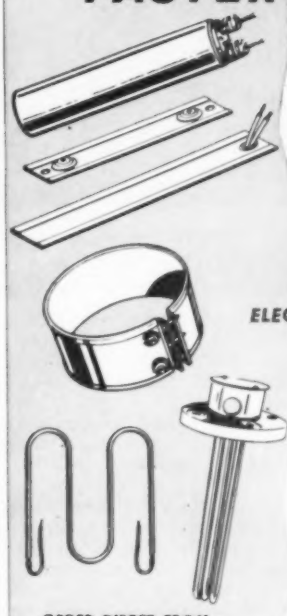

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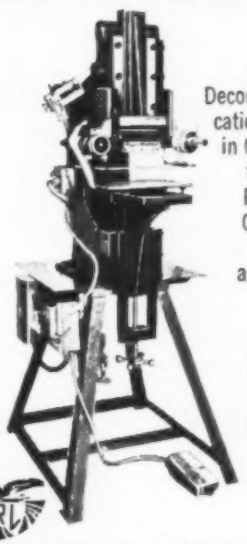

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and special #4-90 (¼ inch) sizes. The first two have fillister heads; the last is headless.

Provided with a jewel socket, the #4-90 incorporates ultra-fine threads for use in meters and other compact, precision instruments. The larger screws, molded to a Class 2 fit, can be used with mating threads in assemblies which require Class 3 fits and better by specifying a female thread with high tolerances. Expected uses include electrical appliances, electronic assemblies, business machines and computers, and instruments.

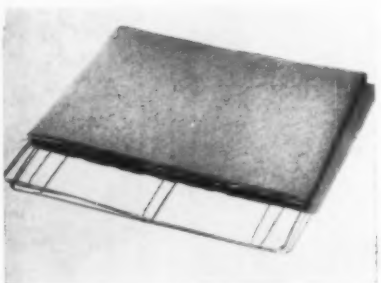
Readers' Service Item 53

Vinyl Highway Markers

Morgan Adhesives Co. has introduced a pressure sensitive vinyl tape for highway and floor marking. Called Mactac, the tape requires no special equipment for its application. Further, no drying time is needed.

The material is reportedly very durable. Its thinness is designed to prevent snow plow and vehicle scuffing. It is made in yellow and white, and is available in rectangular strips. sheets, or rolls.

Readers' Service Item 54



ScottFoam air filter.

Washable Furnace Filter

Auto-Flo Corp. has introduced a washable furnace filter made of ScottFoam polyurethane foam. According to the company, ScottFoam, a product of Scott Paper Co., offers little resistance to air flow, yet has high efficiency and dust-holding capacities.

The filter may be washed by hand or machine with common soaps or detergents. It is then replaced in the retaining frame through a zipper opening.

One-inch thicknesses of the filter are sold in four sizes: 16 by 20 inches, 16 by 25 inches, 20 by 20 inches, and 20 by 25 inches.

Readers' Service Item 55

Styrene copolymer Carpet Guards.

Styrene Copolymer Caster Cups

One-piece caster cups to protect carpets from damage by furniture have been introduced by United States Caster Cup Corp. Known as Carpet Guards, the casters are molded of a special styrene copolymer manufactured by Union Carbide Plastics Corp. for high flexural strength and resistance to damage by detergents.

The cups have teeth that extend through the nap of the carpet to the base. Thus, the weight of the furniture is transferred to the base, while the nap remains resilient.

Carpet Guards are available either round or square for small-leg and large-leg furniture.

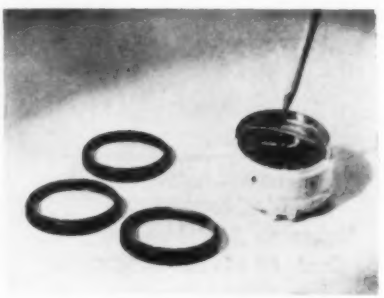
Readers' Service Item 56

One-Piece Lens and Lens Mount

Among the uses forecast for a one-piece plastic lens and lens mount developed by American Plastics Corp. are clock and watch facings, depth gage and other instrument dials, flashlight and lamp heads, transparent packaging lids, and marine, aircraft, and automotive instrument panels.

Eliminating the possibility of a loose lens, the integral unit incorporates a mechanical interlock between the non-shattering lens (polystyrene, acrylic, or other optically clear plastic) and the peripheral case, of any thermoplastic. The bezel case can be designed for a snap fit or a screw thread.

Both parts of the lens are injection molded simultaneously and become a single unit.



Plastic lens and lens mount.

Readers' Service Item 57

Grueling use-test pits monomeric vs. polymeric plasticizers

Some years ago a vinyl upholstery manufacturer decided to field-test new materials for truck and transportation upholstery using a wide variety of monomeric and polymeric plasticizers, including Plastolein 9720. To compare *permanence* and *durability*, the different materials were installed on city bus drivers' seats. Here, seat upholstering would certainly be exposed to extraordinary abuse almost around the clock . . . continuous rubbing and flexing, city grime and grit, oil and grease.

After a certain period of time, all the upholstery containing monomeric plasticizers had failed. But all those made with polymerics, including Plastolein 9720, were still in excellent shape. With this evidence, the manufacturer concluded that only a polymeric plasticizer would meet its standards for truck and transportation upholstering, and protect its reputation. And Plastolein 9720 was chosen on the basis that it was the *lowest cost of all the fine polymerics tested.*

Today, Plastolein 9720 is *still* the lowest cost polymeric plasticizer, and is *still* being used by this and many other manufacturers in such heavy-duty goods. Why not check 9720 yourself? Write Dept. Q-5 for literature and sample.

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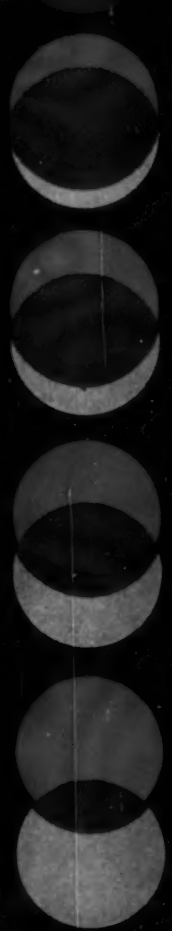

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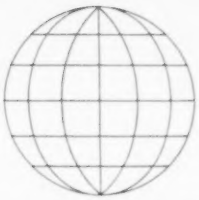

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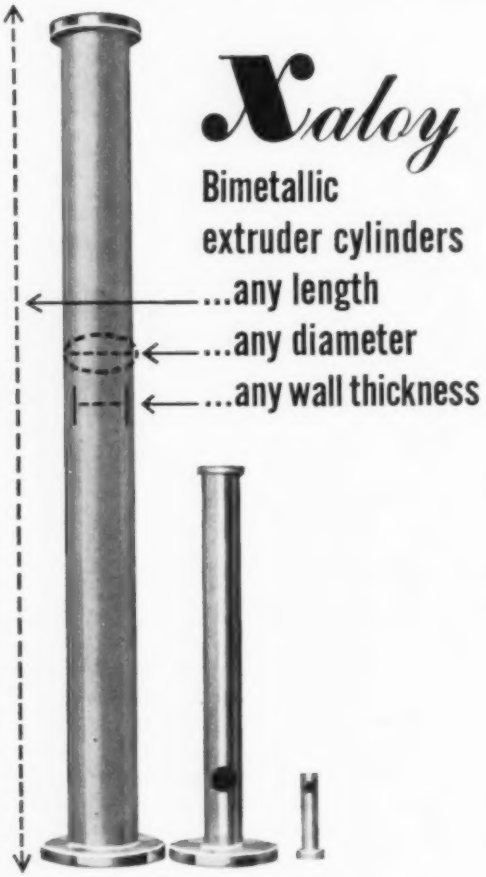

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Book Reviews

"Source Book of Industrial Solvents—Volume 3: Monohydric Alcohols." Ibert Mellan. Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. Cloth, 6¼ by 9¼ inches, 276 pages. Price, $10.00.

Commencing with methanol, this volume presents physical properties, azeotropic mixtures, and uses of industrial alcohols. The brief introduction explains isomerism, primary, secondary, and tertiary alcohols, and nomenclature.

Because of its importance, more than 100 pages are devoted to the history, preparation, synthesis, production, and uses of ethyl alcohol. The Fischer-Tropsch synthesis, catalysts, Oxo Process, hydroformylation, and Oxyl process are treated in their historical contexts.

The compilation includes all commercially important industrial monohydric alcohols.

"Radioisotopes for Industry." Robert S. Rochlin and Warner W. Schultz. Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. Cloth, 5¼ by 7½ inches, 190 pages. Price, $4.75.

Applications of radioisotopes and radiation in industrial research, manufacturing, testing, and control are introduced in this volume. Since the authors have avoided highly technical discussion, they have included bibliographies of technical information on specific applications. Appendices list some radioactive isotopes, technical aspects of radiation, and activation by thermal neutrons.

Radioactive gaging permits measurement at remote locations, without contact, and of material in pipes and tanks. For measuring thin, sticky substances like plastic film, beta-ray thickness gages are particularly useful.

Wear can be measured with radioisotopes. For example, molding compounds affect molds differently. Therefore, in order to develop a phenolic molding compound which would minimize steel mold erosion, the steel was irradiated. Gaging the reactivity of each molded item indicated the amount of erosion per unit.

Other experimenters have discovered that radiation makes it feasible to plate plastic films. In some cases, radiation will form molecular bonds between two otherwise unbondable plastics.

These and other examples are described to inspire and enable the reader to apply radiation techniques in his own problems.

"Machinery's Handbook." Sixteenth Edition. Erik Oberg and F. D. Jones. The Industrial Press, 93 Worth St., New York 13, N. Y. Cloth, 5 by 7¼ inches, 2104 pages. Price, $11.00.

The latest edition of this thum-indexed handbook features over 500 new or revised pages. The section on screw thread systems has been revised to include tables of dimensional data for all classes of Unified threads and hole sizes for tapping Unified threads based on the new diameter tolerances.

New sections feature descriptive and dimensional data for ball, roller, and needle bearings. Information on dimensional and tolerance data for inch and metric bearings, shaft and housing fits, clamping and retaining methods, bearing lubrication, etc. is detailed.

The comprehensive gear section has been amplified with data on enlarged spur and helical gears of seven teeth and up, composite error inspection, checking pressures, and indicator limits.

Additional modified subjects are double-enveloping type worm and intermittent drives, designing and winding springs, involute splines and serrations, and heat-treated steels.

"Control of Variables in Heat Resistant Glass Reinforced Plastics." Volume 1, "Summary Report." PB 151802. 62 pages. Price, $1.75. Volume 2, "Engineering Report." PB 151803. 580 pages. Price $7.00. Order from OTS, U. S. Department of Commerce, Washington 25, D. C.

Results of a detailed research study for the Air Force to provide precise information for designers on the properties of heat-resistant reinforced plastics are compiled in these volumes. Volume 1 is based on the conclusions of the program and provides references to Volume 2, which contains details on the research.

Under contract to the Air Force, Owens-Corning Fiberglas Corp. tested properties of eight resin systems: a conventional liquid polyester, a conventional polyester prepreg, a heat-resistant polyester, a conventional epoxy, a heat-resistant epoxy, low- and high-pressure heat-resistant phenolics, and a heat-resistant silicone. Five types of fibrous glass reinforcements were studied: roving and yarn for unidirectional reinforcement, and the 181, 143, and 120 styles of woven fabric. Three fabric and yarn size removal systems, and application techniques for five finishes, were also examined.

Laminates in three thickness from 0.050 to 0.400 inch, made by vacuum bag, pressure bag, autoclave, and press molding processes, were included.

Conditions for making the highest quality panels for specific properties are stated, with their statistically reliable values and the cases and extent of variations. Standard test, inspection, and quality control methods are evaluated.

"European Technical Digests." European Productivity Agency, 3, Rue André Pascal, Paris 16, France. Paper, 6 by 8¼ inches. Price, $12.00 per year.

This monthly publication is a compilation of abstracts from European technical journals. The purpose of the Digest is not only to spread technical information likely to increase productivity, but to crossfeed ideas from one industry to another.

Dealing primarily with engineering and equipment, the Digest also covers chemicals, textile, and subjects of general interest, such as corrosion, materials handling, packaging, safety, and management.

"Plastics Safety Handbook." Society of the Plastics Industry, Inc., 250 Park Ave., New York 17, N. Y. Paper, 6 by 9 inches, 208 pages. Price, $5.00.

Published in cooperation with the National Safety Council, this manual is reportedly the first devoted to safety in the plastics processing industry. The book is divided into three sections: the first deals with the necessity for and management of a safety program; the second with general industrial hazards; and the third with hazards of specific plastics fabricating processes.

Organization and maintenance of an effective safety program requires participation of all company associates. Management has both a legal and moral responsibility to plan a safety program for employes. Besides discussing planning for safety, the first section provides programs for maintaining interest. Interest, and keeping accident records for cause analysis, are prerequisites of a successful program.

Fire, toxic agents, bad housekeeping, machinery, and materials handling are sources of danger in any plastics plant. They are complicated by the intricacies of fabrication processes. Specific dangers in calendering, coating, and casting; compression and transfer molding; extrusion; injection molding; laminating; mechanical finishing; reinforced plastics; thermal forming; and tool and die making are outlined. After elaboration of the nature of each process, precautions are listed.

Throughout the bulletin, emphasis is on correct and safe procedure.

"Asbestos: Its Industrial Applications." D. V. Rosato, Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. Cloth, 5½ by 7½ inches, 214 pages. Price, $5.75.

Asbestos is the generic name for serpentine and amphibole groups of fibrous inorganic minerals. Because it is comparatively inexpensive, will not rot or burn, and resists heat and chemicals, asbestos finds many applications in industry. The plastics industry employs it as a filler, reinforcer, or additive.

Fortunately, chrysotile, the most important form of the mineral, is also the most abundant. While flexibility and fineness are the qualities important to the fibers, asbestos is generally graded on the basis of fiber length. Detailed tables indicate classifications and grades of different form of asbestos.

Properties of asbestos are tabulated. Extensive tabulation of properties it yields when combined with other materials are provided in the topical chapters on insulation, friction materials, textiles, etc. Processing hints and formulations for compounds are featured in the section on plastics.

New Literature

For more information check Readers' Service Card (p. 103)

"Plastics Granulators, Pelletizers, and Dicers." Bulletin No. 590. Cumberland Engineering Co., Inc. 20 pages. After presenting the criteria for selecting a plastics granulating, dicing, or pelletizing machine, the catalog illustrates and lists detailed specifications for Cumberland equipment.

Readers' Service Item 61

"Summary of Thermoforming Techniques for the Star Press and Rotary-Vac." Comet Industries. 22 pages. Methods of thermoforming, including vacuum forming into a cavity, drape forming, plug assist, inverted drape forming, vacuum snapback forming, billow forming, blow-up vacuum reverse forming, blow-up vacuum reverse into a cavity, and male assist pressure forming, are outlined and diagrammed.

Readers' Service Item 62

"One Hundred Years." U. S. Stoneware Co. 16 pages. This historical company survey is accompanied by humorous sketches and anecdotal "firsts."

Readers' Service Item 63

"Printing of Polyethylene." U. S. Industrial Chemicals Co. 15 pages. Aimed at anyone wishing to print on polyethylene film or molded containers, this booklet covers methods of treating polyethylene film for printability, methods of printing polyethylene, printing inks, and field test methods. Schematic diagrams illustrate flexographic, rotogravure, silk screen, transfer, and offset printing procedures.

Readers' Service Item 64

"Chrom-O-Lite Equipment Systems." Bulletin 2015. Chrom-O-Lite Co. 1 page. The CB-2015, available in three degrees of portability will mix, circulate, control, and supply materials for mixing devices, two-part spray heads, or chopped fiber spray guns.

Readers' Service Item 65

"Merlon." TIB no. 41-M1. Mobay Products Co. 4 pages. Designed to introduce this new polycarbonate resin, the bulletin describes properties, molecular structure, and typical applications. A detailed tabulation of physical properties compares Merlon with seven other common resins.

Readers' Service Item 66

"Table of Properties." Cadillac Plastic and Chemical Co. 2 pages. One side of the chart is a comparative tabulation of physical properties of plastics. The other is a square inch to square foot conversion table.

Readers' Service Item 67

"Coding, Dating, Pricing, Imprinting Machinery." Industrial Marking Equipment Co., Inc. 8 pages. This line of custom-designed machinery is illustrated and described.

Readers' Service Item 68

"A 'Tour' of Tri-Point Plastics, Inc." 6 pages. The bulletin illustrates and describes a plant for producing electronic insulating components of Teflon with very fine tolerances.

Readers' Service Item 69

"Centrifugal Pumps." Bulletin No. 11.0. Vanton Pump and Equipment Corp. 2 pages. Advantages of using PVC and polypropylene centrifugal pumps are presented in text and by graphs indicating performance. The pumps have a wide range of chemical resistance and are available in sizes of 10 through 180 GPM.

Readers' Service Item 70

"Flow Meters." Catalog C20-1a. Minneapolis-Honeywell Regulator Co. 40 pages. The introduction contains general data on flow metering and operating principles helpful in selecting the proper meter. Information on parts of a complete flow meter, which includes the meter body; an indicating or recording instrument; and accessories, primary elements, and control form is presented. The pamphlet concludes with installation data and specifications.

Readers' Service Item 71

"Borden's Chemicals, Polymers, Resins, Adhesives, Coatings." Borden Chemical Co. 35 pages. The catalog describes and tabulates properties of most Borden products, including caseins, phenolics and urea, vinyls, acrylics, styrenes, and elastomers.

Readers' Service Item 72

"Polyethylene Film and Bag Calculator." U. S. Industrial Chemicals Co. A heavy board slide rule, available in metric or British units, is used to calculate bag and film values such as width, length, total area, weight, and gage when only one or two constants are known.

Readers' Service Item 73

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Patent Digest

Materials

Crosslinked Polymers of Ethylenically Unsaturated Blocked Isocyanates. No. 2,882,260. H. Bartle and H. Holtschmidt, Koln-Stammheim, and O. Bayer, Leverkusen-Bayerwerk, Germany (to Farbenfabriken Bayer AG., Leverkusen, Germany).

Thermoplastic Molding Composition of Cyclohexyl Methacrylate, Methyl Methacrylate, and an Acrylic Acid Ester of a Saturated Alcohol Having Less Than Three Carbon Atoms. No. 2,882,261. B. M. Marks, Wilmington, Del. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Process for the Polymerization of Certain Unsaturated Hydrocarbons Using Iron-Based Polymerization Agents. No. 2,882,263. G. Natta, P. Pino, and G. Mazzanti, Milan, Italy (to Montecatini Societa Generale per l'Industria Mineraria e Chimica, Milan, Italy).

Preservation of the Fluidity of Polymethylmethacrylate by the Addition of Finely Divided Silica. No. 2,882,254. H. Kloepfer, Frankfurt am Main, and O. Schweitzer, Konigstein(Taunus) Germany (to Deutsche Gold- und Silber-Scheideanstalt vormals Roessler, Frankfurt am Main, Germany).

Method for Stabilizing Polyvinylpyrrolidone and Compositions Thereby Obtained. No. 2,882,253. T. B. Lefferdink and T. G. Traylor, Concord, Calif. (to Dow Chemical Co., Midland, Mich.).

Polymerization of Ethylene. No. 2,882,264. E. B. Barnes, Freeport, J. E. Thomson, and G. A. Klumb, Jr., Lake Jackson, Tex. (to Dow Chemical Co., Midland, Mich.).

Polyester Composition and a Vinyl Comprising Pyrrolidone Polymer and Method of Preparing Same. No. 2,882,255. J. R. Caldwell and R. Gilkey, Kingsport, Tenn. (to Eastman Kodak Co., Rochester, N. Y.).

Copolymer of Unsaturated Polyester, Styrene, and Dibutyl Fumarate or Dibutyl Maleate and Process of Preparing Same. No. 2,882,256. W. F. Waychoff, Manchester, Mo. (to Monsanto Chemical Co., St. Louis, Mo.).

Preparation of Fluorocarbon Compounds From Phosphorous V Fluoride and Carbon. No. 2,884,467. J. T. Denison and M. W. Farlow, Wilmington, and E. L. Muetterties, Hockessin, Del., and G. H. Whipple, W. Chester, Pa. (to E. I. du Pont de Nemours and Co., Wilmington, Del.).

Polyester Film of 2-Butene-1,4-Diol and Methyl Vinyl Ether-Maleic Anhydride Copolymer Crosslinked with N-Vinyl-2-Pyrrolidone and Process for Preparing Same. No. 2,882,257. F. A. Hessel, Upper Montclair, N. J. and G. Robinson, New York, N. Y. (to General Aniline & Film Corp., New York, N. Y.).

Method of Making Compositions from Vinyl Aromatic Resins and Rubbery Copolymers of Styrene and Butadiene. No. 2,882,258. R. L. Briggs, Shepherd, Mich. (to Dow Chemical Co., Midland, Mich.).

Catalytic Process. No. 2,880,200. M. Feller, Park Forest, and E. Field, Chicago, Ill. (to Standard Oil Co., Chicago, Ill.).

Silicone Pressure-Sensitive Adhesive Tape. No. 2,882,183. H. M. Bond, St. Paul, and G. L. Groff, Roseville, Minn. (to Minnesota Mining and Manufacturing Co., St. Paul, Minn.).

Organic Materials Prepared with the Polyisocyanates and their Preparation. No. 2,882,249. K. W. Posnansky, Stamford, Conn. (to Stamford Rubber Supply Co., Stamford, Conn.).

Process for Preparing Epoxy Resin Modified Proteins and Compositions Resulting Therefrom. No. 2,882,250. E. B. Baker, Belmont, Calif. (to Stauffer Chemical Co.).

Interpolymers of Vinyl Halides Ethylenically Unsaturated Esters and Glycidyl Polyethers. No. 2,882,251. R. M. Christenson, Whitefish Bay, Wis. (to Pittsburgh Plate Glass Co., Pittsburgh, Pa.).

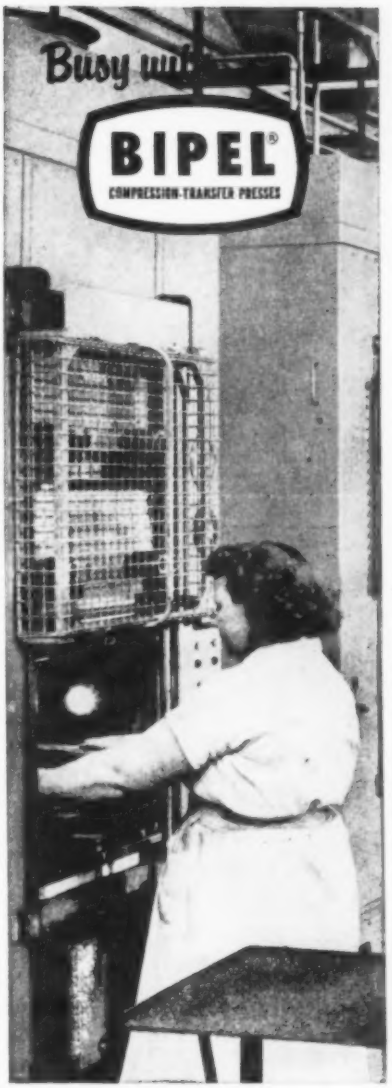
Polymerization of Olefins. No. 2,880,198. W. C. Lanning, Bartlesville, Okla. (to Phillips Petroleum Co.).

Manufacture of Polyolefins. No. 2,880,199. J. L. Jezl, Swarthmore, Pa. (to Sun Oil Co., Philadelphia, Pa.).

Polypropylene Process. No. 2,880,121. W. E. Thompson, Wallingford, Pa. (to Sun Oil Co., Philadelphia, Pa.).

Photopolymerization Process. Nos. 2,880,152 and 2,880,153. A. A. Hiltz, Linwood, and E. G. Lendrat, Narberth, Pa. (to American Viscose Corp., Philadelphia, Pa.).

Copolymers of the Fatty Acid Ester of a Phenoxy Ethanol-Formaldehyde Condensation Product and an Ethylenic Monomer. No. 2,880,187. J. E. Hanle, Westfield, N. J., A. M. Tringali, Springfield Gardens, and H. Yuska, Kew Gardens, N. Y. (to Interchemical Corp., New York, N. Y.).



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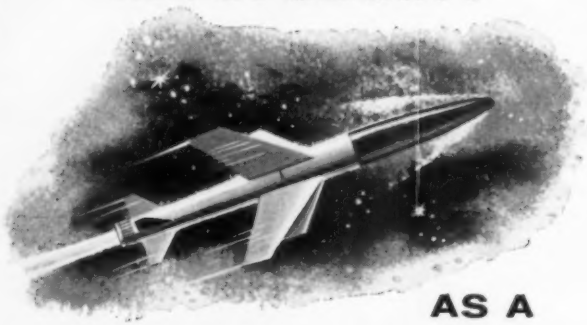

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Patent Digest (Cont'd.)

Cyclic Foaming Method of Making Cellular Plastic Bodies. No. 2,884,386. W. J. McMillan, Midland, and K. R. Denslow, Coleman, Mich. (to Dow Chemical Co., Midland, Mich.).

Alkyd Resin Manufacture with Isophthalic Acid. No. 2,834,390. R. F. Carmody, Metuchen, N. J. (to Socony Mobil Oil Co., Inc.).

Aqueous Solutions of Polyester Resins Prepared by Reaction of a Polyhydric Alcohol, a Partial Allyl Ether of Pentaerythritol, and an Unsaturated Dicarboxylic Acid. No. 2,884,394. R. P. Silver, Kennett Square, Pa. (to Hercules Powder Co., Wilmington, Del.).

Composition Comprising Unsaturated Polyester, Vinyl Monomer, and Cyclic Terpene, Cured Product Thereof and Process of Preparing the Cured Product. No. 2,884,398. P. A. Thomas, E. Orange, and J. L. Welch, Jr., Bloomfield, N. J. (to Union Carbide Corp.).

Compositions Comprising Perfluochlorolefin Homopolymers and Tetraester Plasticizers. No. 2,884,399. W. S. Barnhart, Cranford, and R. H. Wade, W. Paterson, N. J. (to Minnesota Mining and Manufacturing Co., St. Paul, Minn.).

Production of Cured Epoxide Resins. No. 2,884,406. R. Wegler and G. Frank, Leverkusen, Germany (to Farbenfabriken Bayer AG, Leverkusen, Germany).

Cationic Modified Urea-Formaldehyde Resins. No. 2,884,407. G. I. Keim, Oxford, Pa. (to Hercules Powder Co., Wilmington, Del.).

Polymerisation of Ethylene. No. 2,884,409. G. M. M. Bo, A. Fournet, J. A. Phelisse, and E. Fichet, Lyon, France (to Societe des Usines Chemiques Rhone-Poulenc, Paris, France).

Polymerization Process for Preparing Modified Acrylonitrile Polymers. No. 2,883,360. H. W. Coover, Jr., and D. J. Shields, Kingsport, Tenn. (to Eastman Kodak Co. Rochester, N. Y.).

Graft Copolymers Containing at Least Three Components Including Acrylonitrile and a Vinyl Pyridine. No. 2,882,290. H. W. Coover, Jr., and J. B. Dickey, Kingsport, Tenn. (to Eastman Kodak Co., Rochester, N. Y.).

Aqueous Pigmented Dispersion Containing a Butadiene-Methyl Methacrylate Copolymer. No. 2,883,355. B. J. Balfe, Stowmarket, and P. G. Edgerley, Stevenage, England (to Imperial Chemical Industries, Ltd., London, England).

Production of Copolymers of Chlorotrifluoroethylene and Vinylidene Fluoride. No. 2,880,154. J. W. Borland, Massapequa, and E. Schupak, New York, N. Y. (to Allied Chemical Corp., New York, N. Y.).

Patent Digest (Cont'd.)

Cellulose Propionate Compositions. No. 2,883,299. P. W. Kinney, Cranford, and J. H. Prichard, Springfield, N. J. (to Celanese Corp. of America New York, N. Y.).

High Temperature Resistant Molding Composition Containing Phenol Formaldehyde Condensation Product. No. 2,883,-352. O. Sorge, Berline-Frohnau, Germany (to Patent-Treuhand-Gesellschaft für elektrische Gluhlampen m.b.H.).

Stabilized Polyvinyl Chloride Resins. No. 2,883,363. W. E. Leistner, Brooklyn, and A. C. Hecker, Richmond Hill, N. Y. (to Argus Chemical Laboratory, Inc.).

Copolymer of Acrylonitrile, a Quaternary Ammonium Compound and at Least One Additional Comonomer. No. 2,883,-370. J. A. Price, Stamford, Conn. (to American Cyanamid Co., New York, N. Y.).

Polyethylene Compositions Containing 2-Hydroxy-5-Octylbenzophenone. No. 2,-887,466. G. R. Lappin and G. C. Newland, Kingsport, Tenn. (to Eastman Kodak Co., Rochester, N. Y.).

Perfluorochloroolefin Polymer Blends. No. 2,888,364. W. H. Bauer, Jr., Bloomfield, N. J. (to Minnesota Mining and Manufacturing Co., St. Paul, Minn.).

Process for Promoting Adhesion to Difficultly Wettable Polymer Surface. No. 2,888,367. W. L. Greyson, Halesite, N. Y. (to Hitemp Wires, Inc., Westbury, N. Y.).

Preparation of Flexible Elastomeric Polyurethane Cellular Materials. No. 2,888,408, -409, -411, -412, -413. (to Goodyear Tire & Rubber Co., Akron, O.).

Process of Manufacturing Expandable Granules of a Polyvinyl Compound. No. 2,888,410. K. Buchholz, Ludwigshafen (Rhine), Germany (to Badische Anilin- & Soda-Fabrik AG., Ludwigshafen(Rhine), Germany).

Polyethylene Composition Containing Organopolysiloxane Resin. No. 2,888,419. M. M. Safford, Schenectady, N. Y. (to General Electric Co.).

Composition Comprising Chlorosubstituted Ethylene Polymer Plasticized with 1,4-Diaroyl Butane. No. 2,888,423. R. B. Spacht, Kent, and C. E. Sturm, Akron, O. (to Goodyear Tire & Rubber Co., Akron, O.).

Oxyalkylated Polyepoxide - Treated Amine-Modified Thermoplastic Phenol Aldehyde Resins. Nos. 2,888,425, -426, -427, -428, -429, -430, -431. (to Petrolite Corp., Wilmington, Del.).

Curable Polyethylene Composition Comprising a Peroxide Containing Tertiary Carbon Atoms, and a Filler, and Process of Curing Same. No. 2,888,424. F. M. Precopio and A. R. Gilbert, Schenectady, N. Y. (to General Electric Co.).

Process for Dyeing Polyester Materials at Elevated Temperatures in Stabilized Non-Aqueous Disperse Dyebath. No. 2,882,119. J. F. Laucius, Wilmington, Del., and J. P. Neary, Carneys Point, N. J. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Epoxy Resin Compositions. No. 2,890,-204. J. Delmonte, Glendale, Calif. (to Furane Plastics, Inc., Los Angeles, Calif.).

Maleimide Polymers. No. 2,890,206 and -207. E. A. Kraiman, Irvington, N. J. (to Union Carbide Corp.).

Vinyl Halide Resin Containing a Substituted Tin Mercaptide. No. 2,888,435. J. M. Wallace, Jr., Cuyahoga Falls, O. (to Goodyear Tire & Rubber Co.).

Acrylonitrile Polymer Composition Containing the Recurring Unit of a Polymerized Bis(2-Chloroethyl) Vinyl Phosphonate. No. 2,888,434. V. C. Shashoua, Wilmington, Del. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

Vinyl Chloride Resinous Compositions Light-Stabilized with a Dibenzoyl Alkyl Phenol. No. 2,890,201. (No. 2,890,193—polyesters.) W. B. Hardy, Bound Brook, N. J. (to American Cyanamid Co., New York, N. Y.).

Hardening Mixtures of Epoxy Resins and Polyamide-Like Condensation Products and the Process of Producing the Same. No. 2,890,184. W. Foerster, Sao Paulo, Brazil (to Reichhold Chemicals, Inc., Detroit, Mich.).

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Article Abstracts

Materials

"The Physics of Adhesion," N. A. De Bruyne, TRANS. PLASTICS INST., 27, 71, 140 (Oct. 1959).

Some of the reasons are examined for our inability to reach the strength figures predicted by the interfacial forces fundamentally responsible for adhesion, namely: cohesive failure, incomplete contact, residual stress, and concentration of applied load.

"The Assessment of Bond Quality in Glued Wood Joints," R. A. G. Knight, TRANS. PLASTICS INST., 27, 71, 153 (Oct. 1959).

Defective glued joints in wood may be due to faulty adhesive or wrong use of the adhesive. The methods of British Standards for testing the adhesive (by falling load) and for assessing bond quality (by appearance of the broken joint—wood failure) are described and analyzed. Correlation between the two methods is discussed.

"Analysis of Polyesters by Paper Chromatography. II," I. Arendt and H. J. Schenck, KUNSTSTOFFE, 49, 7, 321 (July 1959).

In the paper chromatography analysis of polyesters, described in Part I, the polymers are first sponified in alcoholic alkali. In the presence of fumaric acid, a small amount of ethoxy-succinic is formed as a by-product. To prevent this acid from affecting results, a new chromatography phase was worked out for dicarboxylic acids in which fumaric acid and ethoxy-succinic acid have the same Rf value. (In German.)

"Effect of Plasticizer Content on Thermal Ageing of PVC Compounds," P. Delfosse, IND. PLASTIQUES MOD. 11, 9, 57, (Sept.-Oct. 1959).

The studies to determine the effect of plasticizer content on the percentage elongation at break of thermally-aged loaded and unloaded PVC compounds showed that the higher the proportion of plasticizer, the longer is the flow zone before ageing. Since heat ageing reduces initial flow, the proportion of plasticizer should be reduced to obtain high percentages in retention of elongation at break. If the filler absorbs little of the plasticizer and has a lubricating effect (like Omya BSH), mechanical properties after ageing are as high as for unloaded compounds. PVC-based thermoplastics do not behave like purely elastic materials, hence the mechanical properties at break give no exact idea of their usefulness in service. It is suggested that more attention should be paid to yield point in specifications, as is the case with polyethylene. (In French.)

"Mechanical and Electrical Properties of Epoxy-glass Laminates," L. Blumenthal, IND. PLASTIQUES MOD., 11, 9, 72 (Sept.-Oct. 1959).

After discussing the type of fiberglass fabrics used and their properties for epoxy laminates, the author describes the most important steps in the manufacture of sheet and tubes from these laminates. He then deals with mechanical, thermal, and electrical properties, and the factors which affect them. In conclusion, applications of cylindrical and tubular components are described. (In French.)

"Roll-chilled PE Film," J. A. Doti, G. E. Tolle, and C. S. Imig, MODERN PLASTICS, 37, 4, 109 (Dec. 1959).

How film properties are affected by resin qualities and operating factors.

"Chemical Structure and Stability Relationships in Polymers," B. G. Achhammer, Max Tryon, and G. M. Kline, MODERN PLASTICS, 37, 4, 131 (Dec. 1959).

Techniques used to identify structural changes are reviewed.

One-Shot Urethane Foam," W. E. Erner, A. Farkas, and P. W. Hill, MODERN PLASTICS, 34, 6, 107 (Feb. 1960).

Types of foam that can be made using a special catalyst.

"Do-It-Yourself Polarized Light Tester," P. W. Pugh, W. F. McDonald, and W. V. Funk, MODERN PLASTICS, 34, 6, 114 (Feb. 1960).

Description of a simple tester that can be used in the shop or laboratory.

"How to Measure and Control Static Charges on Plastic Webs," T. F. McLaughlin Jr., MODERN PLASTICS, 34, 6, 120 (Feb. 1960).

A new static testing head is described.

"A New Acrylic Thermoplastic," C. H. Schramm and Joseph Briskin, MODERN PLASTICS, 34, 6, 127 (Feb. 1960).

Properties of Baker PL-11 are given.

"Flexual Strength of Polymethyl Methacrylate at Various Deflection Rates," R. E. Ely, MODERN PLASTICS, 34, 6, 138 (Feb. 1960).

Test results at different testing rates are given.

"Pressures on Objects Embedded in Rigid Cross-Linked Polymers," G. H. Dewey and J. O. Outwater, MODERN PLASTICS, 34, 6, 142 (Feb. 1960).

Experimental pressure values are shown to correspond with theoretical values.

"Dip Dyeing of Finishes for Vacuum Metallizing," R. J. Perkel, PLASTICS INDUSTRY, 18, 2 18 (Feb. 1960).

A brief review of the dye solutions and methods of application.

"Conveyor Belt Laboratory Tests and Their Relation to Field Investigation Group Trial Results," D. Bulgin, TRANS. PLASTICS INST., 27, 70, 117 (August 1959).

The author studies the forces leading to belt damage and the tests for evaluating the properties affected, particularly the notch tear test and impact pendulum test. Results are expressed in a single "belt rating" for each of a number of belts. It is suggested that the method can be used to predict belt performance from laboratory tests.

Mechanical Properties and Chemical Structure of Macromolecular Substances," J. Heijboer, PLASTICA, 12, 2, 110; 12, 8, 598 (Feb. & Aug. 1959).

In these concluding chapters of a series started in November 1957, the author discusses the relation of secondary molecular forces and degree of flexibility of main and side chains to transition temperature, and finally the relation of molecular structure to crystallinity. (In Dutch.)

"Effect of Processing Conditions on Mechanical Properties of Injection Molded Polystyrene Standard Test Pieces, R. Budesheim and W. Knappe, KUNSTSTOFFE, 49, 6, 257 (June 1959).

Standard test bars were injection molded in a multi-cavity mold under systematically varied conditions of cylinder temperature, external injection pressure, plunger forward time and dwell time. Tests gave reproducible values showing the dependence of flexural strength on the above conditions, and also on the position of the samples in the mold. However, the values for impact strength were not easily reproduced. The connection between mechanical strength, orientation, and internal stresses also is discussed. (In German.)

"Long Term Tests on Pipe of Normal Polyethylene," J. H. Gisolf and H. van Goudoever, KUNSTSTOFFE, 49, 6, 264 (June 1959).

A new testing method is described wherein pipe of normal polyethylene is subjected simultaneously to multi-axial stress and high pressure, at room temperature, whereby brittle failure without deformation can be induced in a few hours to days. (In German.)

"Fluidized Bed: Heavy Coatings in One Dip" W. R. Pascoe, MATERIALS DESIGN ENG., 51, 2, 91 (Feb. 1960).

Discussion of the method and its advantages.

"Low Pressure Reinforced Plastics," M. W. Riley, MATERIALS DESIGN ENG., 51, 2, 103 (Feb. 1960).

A discussion of resins, reinforcements, molding methods, and design data.

"Heat Treatment of Compression and Injection Molds for Plastics." W. Haufe, PLASTVERBARBEITER, 10, 3, 97; 10, 5, 177; 10, 6, 209; 10, 9, 345 (March, May, June & Sept. 1959).

The causes of the stresses that arise during the manufacture and hardening of steel molds that result in faulty molds are examined. It is shown how these stresses can be reduced by heat treatment, and proved methods applicable to the various steels used in manufacturing molds for plastics are indicated and illustrated by examples. (In German.)

"Shrinkage and Post-Shrinkage of Melamine Molding Compounds." W. Bauer and W. Gruber, KUNSTSTOFFE, 49, 6, 297 (June 1959).

The characteristic differences in shrinkage behavior of melamine and phenolic molding compounds were quantitatively analyzed by means of a special apparatus. A theory is given for the very marked post-shrinkage of melamine moldings. On the basis of this theory, it could be shown that after-shrinkage is influenced less by pressure than by temperature of the press. Similar studies are in progress on urea compounds. (In German.)

"Improving Screw Extruder Efficiency by Increasing Peripheral Velocity from 0.5 to 7/ms, While Taking Into Consideration Necessary Quality Limits." E. Beck, KUNSTTOFFE, 49, 7, 315 (July 1959).

Earlier investigations or increasing speed of conventionally-designed screw extruders for autogenous operation are discussed and the reasons given for speed limitations. Test results obtained with partial batching in a high-speed machine make clear the measures that should be taken to increase speed limits ten-fold. The economic and constructional advantages of high-speed screw extruders are explained. Finally, the improvements achieved in these machines and their effects on output efficiency are reported. (In German.)

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CALENDAR of COMING EVENTS

May 14-29
Foire de Paris. Sixth Exposition of Plastics Materials and Rubber. Parc des Expositions, Paris, France.

May 20-31
Norsk Plastforening. International Plastics Exhibition. Oslo, Norway.

May 23-26
ASME Design Engineering Conference and Show. Statler-Hilton Hotel, New York, N. Y.

June 9-11
Manufacturing Chemists' Association. Annual Meeting. The Greenbrier, White Sulphur Springs, W. Va.

June 20-24
Gordon Research Conferences. Elastomers—Structure and Properties. Colby Junior College, New London, N. H.

July 4-8
Gordon Research Conferences. Polymers. Colby Junior College, New London, N. H.

July 19-21
Western Packaging & Materials Handling Exposition. Pan Pacific Auditorium, Los Angeles, Calif.

September 8-9
SPE Eastern New England Section RETEC. Vinyl Plastics and Plastics in the Shoe Industry. Statler-Hilton Hotel, Boston, Mass.

September 22
SPE Binghamton Section RETEC. Plastics in Business Machines. Sheraton Inn, Binghamton, N. Y.

October 9-12
ASME Rubber and Plastics Conference. Lawrence Hotel, Erie, Pa.

October 13-14
SPI Sixteenth Annual New England Section Conference. Wentworth-by-the-Sea, Portsmouth, N. H.

October 14-23
French Packaging Institute. First International Packaging Machinery Show, Autopac 1960. Paris, France.

October 17-19
International Congress, 1960, on the Technology of Plastics Processing. Royal Institute for the Tropics, Amsterdam, Holland.

October 19
SPE New York Section RETEC. Tooling for the Plastics Industry. Hotel Commodore, New York, N. Y.

October 19-26
International Plastics Exhibition. macroPlastic 1960. Croeselaan Exhibition Grounds. Utrecht, The Netherlands.

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Domestic Production and Sales of Plastics and Resin Material, Preliminary Total, 1959, and January, 1960

Following are the par ..y estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of 1959 and January, 1960. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

	Preliminary Total, 1959		January, 1960	
	Production	Sales	Production	Sales
Cellulose Plastics:				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	19,481,814	19,024,686	1,465,699	1,225,321
Sheets, 0.003 gage and over	22,580,806	20,629,676	1,676,767	1,362,519
All other sheets, rods, and tubes (including other cellulose plastics)	9,052,366	9,905,850	752,901	726,645
Molding and extrusion materials (including other cellulose plastics)	103,993,473	100,463,205	7,724,267	7,528,024
Nitrocellulose sheets, rods, and tubes	2,980,327	1,969,318	217,352	123,736
TOTAL	158,088,786	151,992,735	11,836,986	10,966,245
Phenolic and Other Tar-Acid Resins:				
Molding materials[1]	225,063,414	206,672,877	19,109,545	16,166,268
Bonding and adhesive resins for—				
Laminating (except plywood)	75,730,181	50,687,877	6,429,305	4,098,492
Coated and bonded abrasives	16,207,682	14,316,702	1,293,538	1,381,374
Friction materials (brake linings, clutch facings, and similar materials)	17,240,628	14,840,213	971,214	1,073,975
Thermal insulation (fiber glass, rock wool)	52,248,850	51,471,436	4,025,379	3,888,694
Plywood	61,251,096	49,964,172	4,672,187	3,958,310
All other bonding and adhesive uses	63,550,542	61,528,721	5,933,417	5,822,145
Protective-coating resins unmodified and modified except by rosin	28,725,820	22,657,703	1,844,918	1,650,282
Resins for all other uses	45,387,190	42,030,094	4,331,181	3,858,281
TOTAL	585,405,403	514,170,126	48,610,684	41,897,821
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	33,541,956	32,110,423	2,889 612	2,621,929
Paper-treating and paper-coating resins	30,473,832	26,552,252	2,188,852	1,993,865
Bonding and adhesive resins for—				
Laminating	36,331,611	28,280,175	2,652,879	2,258,716
Plywood	113,329,130	110,616,815	8,623,366	8,260,945
All other bonding and adhesive uses	24,525,882	19,912,526	1,828,250	1,817,654
Protective-coating resins, straight and modified	37,980,670	27,902,646	3,106,555	2,590,511
Resins for all other uses, including molding	124,703,847	118,940,922	10,346,321	9,743,354
TOTAL	400,886,928	364,315,759	31,625,835	29,286,974
Styrene Resins:				
Molding and extrusion materials:				
Straight polystyrene	278,627,586	248,703,884	22,950,572	17,233,783
All other	366,188,573	313,130,386	35,505,796	27,390,228
Protective-coatings	80,667,739	71,479,765	6,601,715	5,620,480
Textile and paper treating and coating resins	60,798,425	46,039,984	6,323,426	4,496,666
All other uses	146,264,496	182,910,236	11,935,066	15,911,037
TOTAL	932,546,819	862,264,255	83,316,575	70,652,194
Vinyl and Vinyl Chloride Resins:				
Polyvinyl chloride and copolymer resins (50% or more PVC) for—				
Film (resin content)		86,231,874		8,846,172
Sheeting (resin content)		126,039,203		10,244,005
Molding and extrusion (resin content)		304,801,571		21,253,457
Textile and paper treating and coating (resin content)		64,691,109		5,012,495
Flooring (resin content)		151,838,248		12,988,629
Protective coating (resin content)		31,426,812		2,714,895
All other uses (resin content)		94,418,732		8,150,875
All other vinyl resins for—				
Adhesives (resin content)		58,184,308		4,551,349
Protective coatings (resin content)		28,461,940		1,923,444
All other uses (resin content)		130,079,667		10,509,983
TOTAL	1,151,897,189	1,076,173,464	102,068,674	86,195,304
Coumarone-Indene and Petroleum Polymer Resins	259,823,876	258,702,365	19,367,665	19,757,770
Polyester Resins:				
For reinforced plastics	130,424,880	116,563,209	10,840,024	9,400,414
For all other uses	22,026,780	20,667,930	2,160,757	1,640,083
TOTAL	152,451,660	137,231,139	13,000,781	11,040,497
Polyethylene Resins:				
For film and sheeting		345,033,229		28,669,155
Molding materials		212,543,955		12,494,809
Extrusion materials		154,175,147		11,029,883
For all other uses		403,226,403		32,062,027
TOTAL	1,203,639,275	1,114,978,734	113,006,260[1]	84,255,874[2]
Epoxy Resins:				
For protective coatings		20,672,391		2,286,700
For all other uses		23,989,168		2,585,802
TOTAL	55,726,751	44,661,559	4,694,196	4,872,502
Miscellaneous Synthetic Plastics and Resin Materials, Including Silicone Resins	244,429,881	213,689,471	21,757,355	17,893,762
GRAND TOTALS	5,144,896,568	4,738,179,607	449,295,011	376,818,943

[1] 13.1% produced by the low-pressure process.
[2] 12.9% produced by the low-pressure process.
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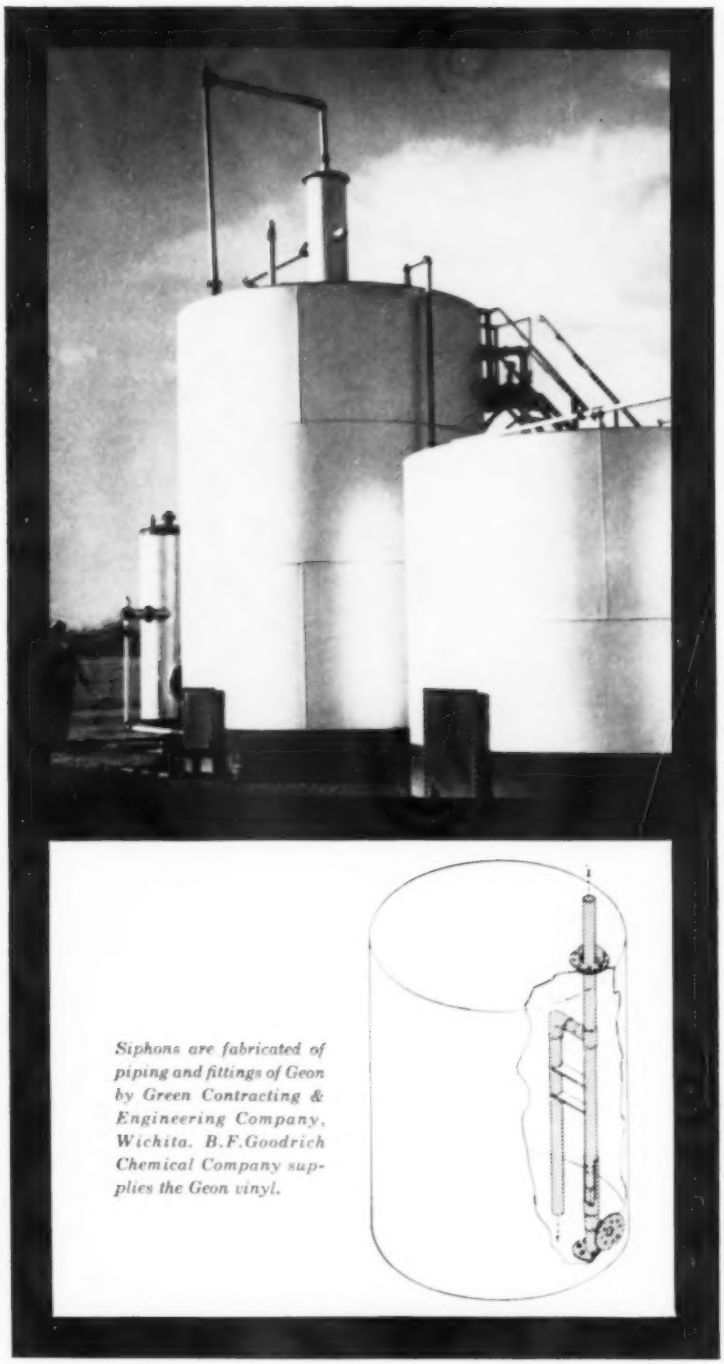

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